Charles E. Kellogg

A F R I C A N J O U R N A L

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Includes visits to the Gold Coast and to the Belgian Congo for the Inter-African Soils Conference and the Fifth International Congress of Soil Science, with field excursions to Low Congo, Tengambi, Elisabethville, and Lufira Valley. Return by Belgium and England, especially for visit to the National Agricultural Advisory Service at Wolverhampton. Many supporting materials are in Appendix. Large maps are in the Appendix to the Congo Journal, 1947.

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AFRICAN JOURNAL

1954

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CONTENTS

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AFRICAN JOURNAL: 1954

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A few weeks before leaving, the Government of the Gold Coast asked the Government of the United States for me to visit that country, and I was advised to do so. I was expected especially to examine the soils of the Accra Plain being considered for irrigation. I was also invited to attend the Inter-African Soils Conference scheduled in Leopoldville just before the International Congress. Finally, it was decided that I should pay brief visits to the Rothamsted Experimental Station and to a provincial office of the National Agricultural Advisory Service of England and Wales on the way home from Africa.

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These notes cover some of the most important items of interest to me. They are not so complete as I should like because of unusual haste and because many observations were made in too much of a hurry to permit orderly note-taking. Since the Proceedings of the 5th International Congress of Soil Science and of the Inter-African Soils Conference are to be published, only a few notes on these programs are included. Notes were taken on the spot, mostly in a hurry, and some may be in error.

No part of these notes is to be quoted without advance approval. Besides the black-and-white pictures, a set of Kodachrome transparencies is on file. Guide books and other papers are included in the Appendix, another volume of folio size.

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Schematic Route of Travel
1954
African Journal

August 1

My large, crowded plane leaves Washington about 9:30 a.m. Here I go again for the cool of Central Africa with Washington sweltering at over 100° F.

I arrive at Idlewild Airport about 10:00 a.m. and transfer my baggage for the flight to Africa. I board the plane at 1:45 p.m. and find no sleeper despite my ticket and reservation. It is very hot.

The motors fail their test at the runway so we go back into the station for lunch, while the mechanics repair the fuel pump on the No. 1 engine. Finally we are away at 5:05 E.D.T. After dinner I doze a bit.

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August 2

At 2:30 a.m. (5:30 local time) we are down in the Azores (Lagos rather than Santa Maria). We have a leisurely breakfast. This post is in a smooth structural valley with basaltic hills. The rich brown soil from basalt is granular but thin on the strong slopes. The area resembles the medium-dry parts of Hawaii.

After breakfast we fly to Lisbon in about 3½ hours and have lunch there about noon, local time. Here we have a long wait. It is moderately cool in the station but hot out in the sun. We are in the air again at 2:10 p.m.

The plane keeps far out to sea, between the Canary Islands and the coast of Africa. About 7:00 p.m. we are passing over desert hard land with a few crescent-shaped sand dunes. I see no animals or people. We are soon over the sea again. The shore line looks sterile - placid sea against the lifeless desert.

The plane is down at Dakar (AOF) at 8:45 p.m. just after a rain. We leave again at 9:45 in utter darkness.

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I am off the plane at Accra about 3:45 a.m. I am met at the airport by Mr. Tom Mead, Permanent Secretary for the Ministry of Agriculture, Mr. C. F. Charter, Director of the Department of Soil and Land Use Survey, and Mr. H. Brammer, a senior soil survey officer. I also talk for a few minutes with Professor Phillips who is leaving on this same plane for Rhodesia. After a few minutes for the formalities Mead takes me to his house where I go to bed.

About 8:30 I dress in field clothes, arrange my kit bag for the field, and come down to breakfast. Both my host and hostess are in the city but the boy takes good care of me. Afterward I repack and leave part of my things chez Mead.

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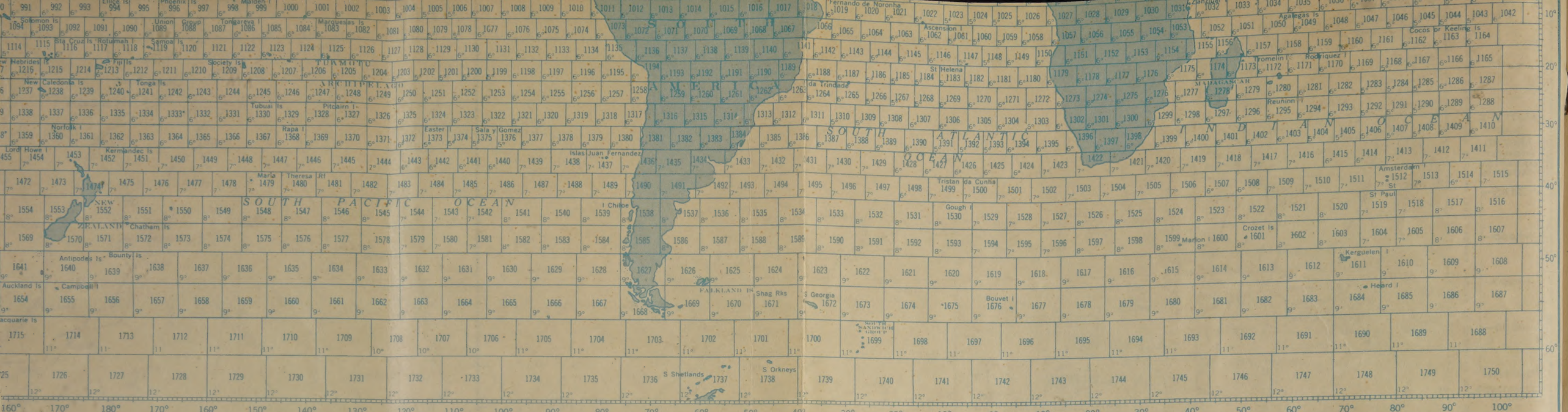
PH
QH
AH
PG
QG
AG
PF
QF
AF
ALTITUDE TINT LEGEND
HIGHEST ELEVATION KNOWN IS
3445
3000
2000
1000
Sea Level
ELEVATIONS ARE IN FEET
CAUTION-Gradient tints delimited by dashed contour lines indicate approximate relief only
CONVERSION OF ELEVATIONS
Feet Meters
4,000
3,000
2,000
1,000
0
1,000
500
0
METERS
KUMASI CONTROL ZONE
ACCRA CONTROL ZONE
TAKORADI CONTROL ZONE
KUMASI
Kokobin
Nkawe Kuma
Mfansi
Kunso
Potrikrom
Dwinyama
Asamankuma
Jamasi
Ntonso
Bekawi
Antobiakrom
Ebiram
Akrokeri
Obuasi
Asokwa
Akrofuom
Domenasi
Dunkwa
Ayanfuri
Atobiasi
Asamang
Acampaniye
Koshea
Weremaso
Brofoyedru
Twifu Praso
Insu
Ateiku
Huni Valley
Tarkwa
Esamang
Hemang
Nfuom
Akutuasi
Benso
Beposo
Aiyim
Impohaw
Sekondi
Takoradi
Pompendi
Dixcove
Elmina
Komenda
Cape Coast
Saltpond
Mankesim
Akra
Apam
Winneba (Simpa)
Senya Beraku
Swedru
Afransi
Bawurampong
Brofoyedru
Esiam
Kwamiata
Jakai
Fanti Nyankumasi
Dunkwa
Aiyinabrim
Foso
Asikuma
Bobikuma
Nyakrom
Kokoso
Brakwa
Akroso
Obiachere
Asamankese
Oda
Manso
Adaiso
Nsawam
Mangoasi
Late Ahaneasi
Dodowa
Aburi
Weija
Botianaw
ACCRA
Tema
Dawhwenya
Anhwiam
Ada
Atiliti
Awunaga
Keta
Keta Lagoon
Songaw Lagoon
Ahume
Tamatuku
Adidomi
Agbakofe
Tawve
Abaw
Djojo
Hevi
Dakpa
Asahoun
Tovégan
Afegame
Kpetoe
Achati
Ho
Anyirawasi
Chito
Abanasi
Awime
Aveno
Agomé-Palimé
Tomegbe
Kpandu
Akukome
British Nyive
Jebikura
Frankadua
Kpong
Akuse
Agbenawsikofe
Otekpawulu
Bisa
Odawminasi
Adukrom
Okrakwajo
Koforidua
Jumapo
Suhum
Bunsu
Anyinam
Kankang
Akwaseho
Nkawkaw
Abene
Adawso
Mankrong
Seidu
M'Poti
Bonkrom
Moano
Agogo
Juansa
Konongo
Bompata
Kwaso
Ejisu
Afoso
Ntronang
Chia
Ofuasi
Akokoaso
Aiyiribe
Fumso
Kade
Pramkese
Akropong
Otumi
Asuom
Lake Bosumtwi
Ongwam
Afram
Fo
Fa
Ada
Akwale
Kume
Anum
Dome
Fwere
Subri
Pra
Ofin
Fum
Mansi
Mankrangkese
Oda
Banko
Tim
Butre
Volta
Aiwo
Avato
Aklakba
Adawji
Avo
Avu
Lagoon
Toli
Awamo
Gbi
AUGUST 31st 1916
AUGUST 31st 1916
ACCRA
243 LH 73
Airport of Entry
5680 118.1 mc
CS
ACCRA
6517 ZNT
DF
ACCRA
4575 ZNT
RBn
ACCRA
380 AA
Gp Fl
RBn
TAKORADI
400 TK
(On Request)
Gp Occ W-R SEC
TAKORADI
20 LH 57
Airport of Entry
118.1 mc
KUMASI
943 -H 45
5680 118.1 mc
(On Request)
KUMASI
6517 ZBQ
(On Request)
RBn
KUMASI
275 :I
(On Request)
Southern Gold Coast
2053
2078
2077
1905
2321
2093
2067
2586
2151
2370
2344
1441
1848
1556
1400
1021
1618
476
450
1106
902
764
641
1135
1814
3133
3445
FERRY



WORLD AERONAUTICAL CHART INDEX

Scale of Series 1:1,000,000

Southern Gold Coast

WAC (BU-10)

AERONAUTICAL SYMBOLS

RADIO FACILITIES

All frequencies are kilocycles unless otherwise stated
Methods of indicating specific voice and CW calls are shown below

Radio Range (With voice) — WOODY RADIO 291 AB

Radio Range (Without voice) — WILLOW RANGE 320 KB

Non-Directional Radio Beacon (With voice) — R Bn EVERETT BEACON 224 MMC

Non-Directional Radio Beacon (Without voice) — R Bn EVERETT 224 MMC

Marine Radio Beacon — M R Bn ISLAND 309 BO

Radio Direction Finder (With voice) — D F MANUA HOMER 116.1 mc

Radio Direction Finder (Without voice) — D F MANUA 4595 VFPW

Radio Communication Station (With voice) — C S GOWEN AIRWAYS 4765

Radio Communication Station (Without voice) — C S KAZAN 5200 WYZW

Radio Broadcasting Station — B S WOL 1260

Radar Beacon (Racon) — RACON CHANNEL X 1-2-2

Radio Fan Marker Beacons — ARK, NAN

International Boundary (Closed to passage of aircraft except through air corridor)

AIRCRAFT LANDING FACILITY INFORMATION

RAMEY AFB 18 LH 46 Airport of Entry

RADIO FIXES

Reporting point.

CASE INTERSECTION

TOPOGRAPHICAL SYMBOLS

CITIES and TOWNS

Metropolitan Areas — NEW YORK

Large Cities — RICHMOND

Cities — ARLINGTON

Small Cities — SANGATE

Large Towns — Corville

Towns & Villages — Arcola

HIGHWAYS and ROADS

Dual Lane Highways

Primary Roads

Secondary Roads

Trails

U. S. Road Markers — 60

National, State or Provincial Road Markers — 37

Road Names — ALASKA HIGHWA

RELIEF FEATURES

Contours: Reliable; Depression; Approximate — 1000

Bluffs, Cliffs & Escarpments

Sand: Dunes; Areas; Ridges

HYDROGRAPHIC FEATURES

Swamps & Marshes

Mud & Tidal Flats (Exposed at low tide)

Fathom Line (Dots uniformly spaced) (1 fathom, 6 ft. below mean low water level)

Danger Line (Dots grouped in pairs) (2 fathoms, 12 ft. below mean low water level)

Streams & Rivers: Perennial; Intermittent; Probable or Unsurveyed; Braided

Intermittent Lakes

Drainage Ditches

Charter, Brammer, Mead, and I have a visit about plans and lunch. About 2:00 p.m. Charter, Brammer, and I leave by car for Kumasi. We drive out north of Accra. Just here the red soil has lateritic concretions under a rainfall of 28 inches, which increases as we go into the hilly country back from the sea. At first we are on the well-drained, undulating peneplain of the Accra Plain. This is underlain with Archean crystalline rocks. The red soils are said to be neutral in the surface, slightly acid in the "B", and neutral again in the substratum. Here, near Accra, the vegetation is mixed shrub or thicket and savanna with termite mounds 3 to 5 feet high at about one for each one or two acres. This soil may be used for 2 or 3 years, mainly for cassava, and is then fallowed under brush and savanna for 10 to 20 years.

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As we go on the rainfall increases, the soil has been more recently under heavy tropical forest, and the pH is lower, especially in the "C". We go up a sharp escarpment to a higher level. The Paleozoic rocks are mainly metamorphic, especially quartzites. Just before, and here, food crops include cassava, bananas, papaya, and maize. We stop for a moment to look over the Accra Plain, which is mainly a low undulating plain from crystalline rocks. I should say that in the foreground about 15 percent is in crop and 85 percent in savanna-thicket. Food crops include maize and cassava mainly, with some peanuts and coco-yams. The villages are fairly permanent, but do move if crops are poor. Food crops and firewood are sold.

As we go on to the northwest over the more rolling part of this ridge I see some cacao. I notice this forest has the three characteristic layers: (1) a low one at about 30 feet; (2) the canopy at about 120 feet; and (3) the emergents above 120 feet.

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The cacao farmer cuts out the lower layer, thins the canopy, and replaces the lower layer with cacao. At first he plants coco-yams, cassava, maize, and some bananas (plantain). Amongst these he starts the cacao seeds. The first year he harvests the maize; the second year the coco-yams and cassava; and finally the bananas. Then brush takes over. He keeps the brush cut away from the cacao seedlings for 5 to 10 years. Two or 3 years after clearing the cacao becomes nearly a closed canopy. Since the normal canopy was thinned, under good growing conditions the cacao becomes the only closed canopy of the forest. (Charter promises me more detail on cacao culture later).

I am told that no fertilizer of any kind is used on the cacao. In old plantings, the big cacao trees die out. It is said that commonly the cacao plantings die out in about 20 years or so. Most of the cacao farms run around 2 to 3 acres. Many of them are held by non-resident owners. The fact is that some owners may have 10 or more of these small farms.

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We stop for a moment in an old cacao farm. Many of the existing trees came from shoots out of older stumps. This is a common practice for getting young trees, but only the shoots at the very base should be allowed to grow since these will throw out their own roots. The little plot here is probably 50 years old. The original planting was probably about 7 feet by 7 feet; now the trees are about 12 to 20 feet apart. Many of the old trees are gone and have been replaced with bananas. Charter calls this the Abotakyi soil series. The rainfall is 45 inches. I try to get some pictures here but they may not turn out well.

We pass the village of Amanokron in some haste. This area is quite well populated and the natives appear to be healthy. We turn west through areas said not to have had the swollen shoot disease. A mile or so beyond Manfe we stop and look at a cacao planting. I see plenty of black pod disease and some mealy pod. Although it isn't supposed to be here, I see a good example of swollen shoot, the most serious virus disease of cacao.(K2201). This planting was made over an old home site and I take a picture of the meal-grinding stone. Mr. Charter tells me that this is the first time swollen shoot has been seen "on the ridge."

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K-2197 Aug. 3, 1954. Gold Coast. One mile south of Amanokron. View of old cacao planting on Abotakyi soil. Rainfall here 45 inches. Charter, L; Brammer, I

K-2198 Aug. 3, 1954. Gold Coast. A view one mile south of Amanokron.

K-2197 Aug. 3, 1954. Gold Coast. One mile south of Amanokrom. View of old cacao planting on Abotakyi soil. Rainfall here 45 inches. Charter, L; Summer, R.

K-2198 Aug. 3, 1954. Gold Coast. A view one mile south of Amanokrom.

K-2199 Aug. 3, 1954. Gold Coast. Near Manfe. In old cacao grove. Note old grinding stone of prehistoric natives by cacao tree.

K-2200 Aug. 3, 1954. Gold Coast. Near Manfe. View of cacao farm with part of shade trees. (Banana interplant).

K-2199 Aug. 3, 1954. Gold Coast. Near Manfe. In old cacao grove. Note old grinding stone of prehistoric natives by cacao tree.

K-2200 Aug. 3, 1954. Gold Coast. Near Manfe. View of cacao farm with part of shade trees. (Banana interplant).

We drive off the ridge into rolling forested country. I notice quite a lot of oil palm coming up wild in thickets and forests. It is not cultivated, but in land clearing the plants are preserved and the oil is used in the homes by the natives.

We drive on very rapidly because there are many miles to go before darkness. I notice that except for the small children natives here are more completely clothed than in the Congo.

We pass on to Red Latosol with just a bit of cacao left. Originally there were heavy plantings here but they have largely disappeared because of swollen shoot.

We pass milepost 46 from Accra and go through Koforidua. Here the rainfall is about 70 inches. December, January, and February are quite dry. Then it is wet, beginning in April and running through July. This is followed by an unreliable dry season from mid-July to mid-September. Then it is wet again until the end of November.

Just beyond this last town we stop in an old planting cut out because of swollen shoot that is now reseeded to cacao. I notice that coco-yams are coming in as volunteers.

We pass Nkawkaw and I try photos of another cacao planting.

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We pass on to Red Latosol with just a bit of cacao left. Originally there were heavy plantings here but they have largely disappeared because of swollen shoot.

We pass milepost 16 from Accra and go through Koforidua. Here the rainfall is about 70 inches. December, January, and February are quite dry. Then it is wet, beginning in April and running through July. This is followed by an unreliable dry season from mid-July to mid-September. Then it is wet again until the end of November.

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K-2201 Aug. 3, 1954. Gold Coast. Near Amanokron. Close view of cacao tree showing the swollen shoot disease.

K-2202 Aug. 3, 1954. Gold Coast. Near Nkawkaw. Characteristic cacao farm from roadside.

K-2201 Aug. 3, 1954. Gold Coast. Near Amanokwon.
Close view of cacao tree showing the swollen shoot disease.

K-2202 Aug. 3, 1954. Gold Coast. Near Nkawkaw. Characteristic cacao farm from roadside.

Soon it is dark. We drive for about 45 miles in darkness and arrive at Kumasi about 7:30. I am taken to the official government residence. Mr. Gass, Administrative Officer for the Ashanti District, is my host. After a quick drink I go to my room to undress. I discover that I have lost my suitcase key! What a time! Mr. Gass finds some old ones and with a whetstone from my field kit I finally shape one of these and make it work.

Unfortunately, we had to drive so very fast that I had little chance to see the soils on this 180-mile ride. Most of them are red -- some strikingly so. Nearly all of them seem to have a concretionary layer at one to three feet.

The boy brings me a little supper and I am early to bed.

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The boy brings me a little supper and I am early to bed.

K-2203 Aug. 4, 1954. Gold Coast. A view in the garden of the residency at Kumasi. Kapoc tree in background.

K-2203 Aug. 4, 1954. Gold Coast. A view in the garden of the residency at Kumasi. Kapoc tree in background.

Kumasi. The administrative buildings, Department of Soil and Land-use Survey.

IV-a

GOLD COAST DEPARTMENT OF
SOIL AND LAND-USE SURVEY

The Administrative and Technical Block.

Kumasi. The administrative buildings, Department of Soil and Land-use Survey.

August 4

Up at 6:00 a.m. with a cool morning about like Washington near the end of May. The garden of the Residency has many chirping and singing birds. First, the boy brings tea, then breakfast; meanwhile I write letters.

I step down into the garden. Many of the plants grown here are like those in the English gardens - dahlias, zinnias, and the like. Roses are in great wooden tubs, I suppose because of termites. (I believe the termites would leave the roses alone if these English gardeners in the tropics wouldn't rake all the sticks out of the soil). Also the garden cannas, kapoc trees, and other tropical things. I see that they have many yard boys for these Residency gardens.

About 8:30 a.m. Mr. Brammer calls for me. We stop at the bank en route to the Department of Soil and Land Use Survey. This is an independent department within the Ministry of Agriculture on a comparable status to Agriculture and Animal Health.

Upon arrival at the headquarters, I go to Charter's office and he explains. He is a man of medium height, perhaps 49, but looks younger; wears glasses well down on his nose; and sits in a straight chair back of his desk. He goes on like a 19th century schoolmaster - not in a dull way, but with spirit and grunts. Around his office I note very well-worn copies of American papers - such as the Puerto Rico soil survey and the 1949 special issue of Soil Science.

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He begins by summarizing some of his ideas already published in the proceedings of the Goma Conference and elsewhere, and by explaining his survey, organized in 1951. (See Charter's paper in the 1953 Cacao Conference in London). Charter explains that in the soil survey work he must think of the cultivator as well as the soil. He uses many Africans in his organization (about 171 in technical jobs). Costs may be somewhat higher than they would be by having a higher proportion of English on the staff. But, he says, a broad education in soils by native technicians and native farmers is essential for effective use to be made of the soil survey. (Obviously Charter is a natural-born teacher, outwardly autocratic perhaps, but spiritually democratic and, almost in spite of himself, in love with the so-called human race.)

Charter says that he has had trouble getting underway because of the inexperience of his new personnel from the United Kingdom. I take it that he means inexperience with natives as well as with tropical soils. He prefers a staff with basic training in physical geography, as taught at Cambridge. He says that his Miss Brash is a good example. Later, she will be placed in charge of soil correlation. I am very pleased to see his recent emphasis on geomorphology, but hope it doesn't go too far. He says further that good chemists are scarce in the United Kingdom.

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He has 10 soil survey officers, mostly geographers except for one geologist and one agriculturist. He has two soil analysts (chemists). Mr. Wills, his compilation officer for both maps and texts, is a geographer. He has one grassland ecologist. Two-thirds of the area of the Gold Coast now is covered with grass. (This is, of course, anthropic grassland). Charter says that in his view soil conservation is simply applied geomorphology. Of course, to me this is much too narrow a view of soil conservation; but I assume he refers only to the one aspect of it, erosion control.

All this time Charter lectures. On his desk is a great bell. From time to time he hits it vigorously, once, twice, or thrice for different people. They bring him books, notes, maps, and the like to refresh his mind while he talks to me. After their errands they are immediately dismissed. When one stays a moment, Charter says, "Go, you put me off." But Mr. Brammer stays nearly the whole time and some of the others for a while as special points are discussed.

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Charter speaks a bit softly. Nearly half his sentences end as questions, followed by one to three short grunts. But he doesn't want comment, not until he finishes a thought. It "puts him off."

Besides 171 technical and subtechnical Africans, he has 154 African laborers. Charter says one can get good African assistants if they are given much personal supervision and a narrowly defined job that can be done in a routine manner. They can be trained best in the field where they can be kept under nearly continuous supervision.

Charter explains that the kind of survey he is doing requires many laborers. Generally he uses drainage patterns as the unit of survey rather than political subdivisions. He then outlines his types of survey.

1. The preliminary survey. This survey is aimed to assemble the basic knowledge for a reconnaissance survey. All assembled information is gathered on roads, food sources, and the like. Then the mapping units are defined as kinds of soil and soil associations. This activity amounts to our development of the descriptive soil legend. It is very difficult to deal with the vast amount of information that comes in to the survey organization. This synthesis requires experienced officials. He even warns against collecting more information than can be used.

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He is undertaking also a somewhat different type of preliminary survey that requires one mile of traverse for each 5 square miles. Such a survey has about 1/5 of the detail of a standard reconnaissance survey. The traverses are planned by study of the relevant data in advance. First, a schematic soil map is made in the office. Boundaries are checked in the field from traverses and corrections are made in soil identification and land-use delineations.

2. Reconnaissance surveys. For these surveys, lines are cut about 1-1/4 miles apart at right angles to the drainage. Soil, vegetation, and land-use are noted at each 10 chains (= approximately 200 meters) along the traverse.

From the field data a soil association map is drawn in the field technical office. Because of the very heavy bush in the forested country, soil patterns cannot be seen in the field. In many areas one can see only a few feet from the traverse line. These surveys are planned with a standardized grid because the basic work is done by Africans having only a primary school education. But the soil survey job is far too big to expect progress with only a few European officials.

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The soils are identified from field notes and samples in the field survey party headquarters. Samples and notes about unknown soils are sent for identification to the main headquarters. They use the Munsell color notations and the Morgan pH test. They also use a test called "field texture," which is a kind of modification of the Atterberg test rather than particle-size distribution. Besides, the usual notes are taken on slope, stoniness, total depth, horizon thicknesses, etc. A reconnaissance soil survey party goes to work usually after a preliminary survey.

3. Detailed soil survey. Detailed soil surveys are made of sample strips. As near as I can gather, these are about 2 to 4 times as long as they are wide, not strips up hill and down dale over long distances. Within each recognized soil association one of these sample strips is put down for detailed maps of soil, vegetation, and land use. For important soil associations, several strips are put down. They are usually 1/4 mile wide. At 4 chain intervals subtraverses are cut which cross the lines of the reconnaissance survey at about 40-chain intervals. With the use of the Abney level they are able to develop 5-foot form lines to indicate the relief. Complete soil notes and samples are taken for identification at 4-chain intervals.

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The soils are identified in the field soil survey office. The field record indicates horizon limits, topography, general vegetation type, direction of slope, etc. From these data a provisional soil map is made with boundaries by interpolation. Then the senior officer determines where additional examinations are needed for greater accuracy and lines are cut at 2-chain intervals. From these additional data a modified soil map is made. These strips representing the soil associations are laid out roughly at right angles to the drainage.

I am shown a general vegetation map. This one has only three categories: (1) broken forest; (2) cultivated land; and (3) areas of forest regeneration. I note that the legend for the land-use map gives the detailed cropping system: kinds of crops, spacing, and condition.

The survey party also makes spot sketch maps of the forest by recording all trees to scale for 1/2 chain each side of the cut line. This results in three separate maps: (1) the shrub layer; (2) the canopy layer; and (3) the emergent layer.

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The survey party makes a sort of base map with miscellaneous information including roads, streams, rock outcrops, termite mounds and the like.

Thus, in summary, 13 maps are made on each strip as follows:

1. Location map.
2. Empirical relief and drainage.
3. Spot heights by Abney level.
4. Form lines by interpolation.
5. Provisional soil map.
6. Modified soil map (with data from additional 2 chain spots).
7. Final soil map with data from profile pits.
8. Vegetation map.
9. Land-use map.
10. Tree spot map (shrub layer).
11. Tree spot map (canopy layer).
12. Tree spot map (emergent layer).
13. Miscellaneous information.

Samples are taken from profile pits for analyses. About 30 pits are used for each soil series in order to establish the modal profile. A few of these detailed maps are published with the survey area to illustrate the characteristic patterns of the associations. If a detailed soil survey is defined as one in which the boundaries are sketched from observations throughout their course, even these maps would scarcely qualify. Boundaries are hard to determine in dense forested areas.

A few detailed soil maps of experimental areas are prepared from cut-line grids only 1-chain apart.

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We have some argument about the so-called "texture test". In my view it is a general single-value physical test that is a sort of summary result of particle-size distribution, kind of clay, kind of exchangeable bases, content of organic matter, and structure.

First, the soil is screened through a 2 mm. screen and mixed with water. The technician makes as thin a thread as he can with his fingers. He will make the lowest form possible on the following scale:

Form	Term Used
cone	sand
sphere	sandy loam
large cylinder	light loam
medium "	medium loam
small "	heavy loam
very small cylinder	light clay
good ring	clay

I am not saying that this is not a practical test to use, but I certainly do not like to see it called "texture". Charter thinks the question is mainly semantic. He says, "What means the word texture?"

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We step into the musuem for a few moments. I'm especially interested in the story about the calcium-collecting tree called Chlorophora excelsa, one of the emergents. Locally it is called "odum." This tree collects calcium which oozes into old wounds and cuts, probably as calcium malate. This generally changes to a kind of limestone that runs about 80 to 90 percent calcium carbonate. I photograph a very large one about 2½ feet high and he gives me a small one to bring home. The soils under such trees become neutral to alkaline, whereas the soil under adjoining trees may be strongly acid. The surface soil under the odum may go up to pH 7.5 or even to 8.0 while the lower soil may be acid. I'm told that other trees in the Gold Coast and in other parts of Africa have a similar but smaller effect. We find that the laboratory had analyzed a bit from the sample I took and this one has about 2 percent magnesium carbonate.

Charter has a large setup here and we take a quick tour of the workshops, sample rooms, library, map room, and laboratory. He seems to have a qualified chemist in charge of the laboratory, Mr. A. S. de Endrey.

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K-2204 Aug. 4, 1954. Gold Coast. Kumasi. A large limestone concretion produced by the Odum tree. (Chlorophora excelsa).

K-2205 Aug. 4, 1954. Gold Coast. Near Kumasi. Thin Red Latosol from "drift" over laterite crust in upper part of weathered phyllite. Note roots concentrated just above pan.

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Kumasi, August 5. Charter, L.; Kellogg, R.

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Kumsal, August 5. Charter, L.; Kellogg, R.

We then go back to Charter's office where he lectures me on philosophy. He says he doesn't agree with the "official" type of agriculture. He thinks there is too much effort to introduce the English type of mixed farming. In the tsetse fly areas, the "official" suggests a rotation of crops in pure stands. Many of the so-called grass leys are simply weeds. He thinks that one of the worst hazards in the tropics is the old Norfolk (four course) system of farming. He feels that for a long time the maintenance of soil productivity (and I'm assuming he is talking about the humid tropics - the Latosols) will be based on vegetation fallows. He does not hope for much from grass leys. He says that we need many dicotyledons in order to get the phosphorus and the divalent bases like calcium returned to the surface. He thinks we need research to find the best types of bush that will rejuvenate the upper part of the soil.

As he waxes enthusiastic Charter expresses some doubt about the applicability of the concept of climax grassland anywhere in the world!!! Here he certainly takes in a bit too much territory - I hope we can get him into the Great Plains. Charter wants more plant analyses so that he may identify shrubs that have high contents of phosphorus, calcium, and magnesium. He seems to favor legume shrubs.

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Charter expresses great anxiety over the possibility of agricultural mechanization on the kind of soils (Latosols) in the southern Gold Coast. (I agree). He says the Africans love the machine and those that go to western Europe and the United States are anxious to mimic our systems of farming. He doesn't see how the productivity of the soils could be maintained because they don't know yet how to fertilize. Charter does not now favor plowing here. He suggests that mechanized cutting of the bush down to the ground level might be practical. For this we might need to plant the shrubs in rows.

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The bell again! (Mr. Wills comes in and is asked for a map). Charter says we must learn to modify the native agricultural system. (This reminds me of Jurion). He says that fertilizers must be used under control, as I agree that good farmers in advanced agricultural areas do now. He points out the need for more plantations in the Gold Coast where industrial crops can be grown under control. These estates could produce export crops, food crops, or both. They could be managed as industrial concerns, at first with European managers training Africans, and later by African managers. With an estate of 2,500 acres for cacao or oil palm, a specialized staff could be afforded. The land might be held by special corporations with a commercial firm brought in to manage the estate. In due course, the white managers would be replaced by African managers and outside advisors.

Such estates would provide good outlets for trained personnel. I agree that Charter has very good arguments but of course this idea of estates is not particularly popular in the Gold Coast at the present time.

We go to lunch chez de Endrey. de Endrey was trained in Hungary with the d'Sigmond. Although quite a talker, he looks like a good man to me. At the close of World War II, he worked with the American Army and then ran away when the Russians came in. He will be a British subject shortly. Madame de Endrey gives us a very nice lunch. She can even out-talk her husband.

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After lunch we go back to the laboratory and organize a small field party including de Endrey, Brammer, Charter, Ahn, Crosbie and Miss Brash. Miss Brash is a characteristic serious young English lady who finds herself in the tropics although she is most interested in an opportunity to study glaciers and glacial geology. She has had one study trip in Iceland.

First of all, we go to a pit in Charter's yard. The soil is said to be "drift" over residual material from phyllite. (Charter says he is not going to give me time to describe profiles in detail! He certainly should have left off the "in detail"). Very, very roughly this profile is about as follows:

A	0-18"	Disturbed. Reddish-brown clay with medium irregular, medium granular (5YR 4/2).
B	18-72"	Moist in lower part. Red to orange-red clay (2YR 4/6?).
C	72-80"+	Red fragmental weathered phyllite (7.5R 3/8).
		Stone-line at contact of B and C.

This looks a bit like loess over an old erosion pavement.

A bit further away, near the edge of the peneplain, I am shown an exposure of hard laterite at the surface of the older weathered formation. I see several of these examples of thin "drift" over lateritic crusts or lateritic concretionary layers. Lateritic horizons may be in the drift above the contact or in the weathered material just below it.

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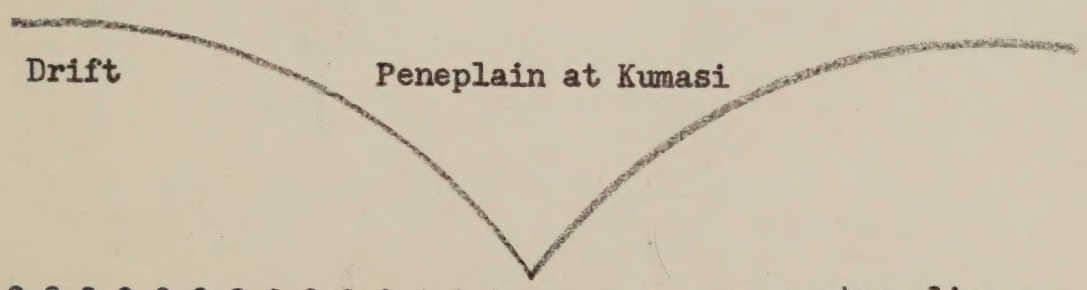
Charter shows me an undressed profile of Bekwaa soil. He says this is approximately the standard profile for this area. He says that the A horizon is about pH 7, the A_2 between 6 and 7, the B between 5 and 6, and the C about 4.5; and near the D the pH is usually higher again. Where I look at the soil, the A_1 is about 3 inches thick and consists of a dark grayish-brown clay loam with much granular soil from worm casts. The A_2 goes to about 8 inches and is nearly structureless although very friable. The lower boundary of the B here varies from 30 to 52 inches deep. The red clay has an angular, irregular, and ill-defined blocky structure with some rounded lateritic concretions and quartz pebbles in the lower part. Beneath is weathered granite. Quartz veins are common in C and D. We get in and out of the car to see many examples of the same thing with scarcely a moment for pictures or notes.

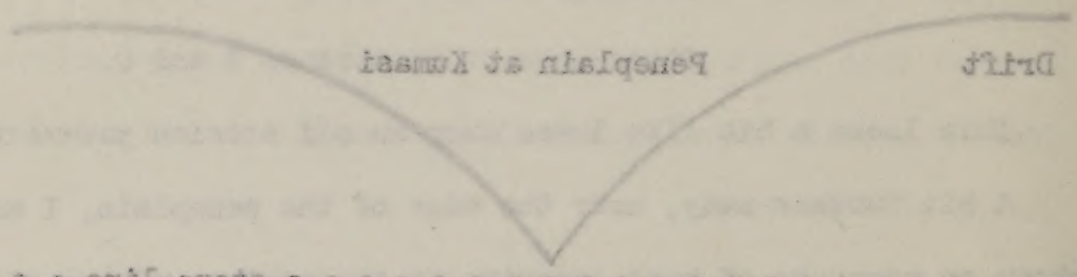


o o o o o o o o o o o o o o o o o o o o o o o o o stone-line o o o
x x x x x laterite x x x x x x x x x x x x x x x x x x x x x x x

<u>Drift:</u> A cover about 5 to 6 feet deep.
Where deep, soil is good for cacao.
When removed, laterite hardens. Commonly has band of lateritic concretions.

<u>Stone-line:</u> Old erosion pavement

<u>Laterite horizon:</u> Soft or hard, depending on exposure.



Weathered phyllite

We go again to the home of Mr. de Endrey for tea and pleasant chitchat. I stop for a while at the laboratory and then go back to the Residency about 6:15 p.m. I'm dressed and ready for dinner about 6:45 p.m. This evening is warm, about right for shirt sleeves.

My visit with Charter was very interesting. About one-third of his sentences end up "What, ugh, ugh ...." This is not a question; he dislikes anyone to break in with even a "yes."

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I point out that most Europeans and Americans who go to the tropics first try the kind of mechanized farming used at home. I believe this to be wrong. Rather we must invent machines to speed up and to make much easier systems of agriculture adapted to the tropics based, in the first instance, on native practices as these are gradually improved through local research on the ground. For this reason I give greatest emphasis to strong basic soil research institutes within the tropics. We also discuss the failures of monoculture and the false reasoning by analogy from sugarcane to several other unlike crops grown in the tropics. I also emphasize the evils of the one-crop specialized experimental station.

And so to bed in a great big room of the Residency, guarded by a native from the Northern Territory equipped with a bow and poisoned arrows.

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August 5

I'm up with the birds. It is still mildly cool but warmer than yesterday. During early tea and breakfast I review some of yesterday's notes.

According to plan, Mr. Gass takes me down to an ivory carver where I buy some salad forks from Sam Tepe. We are back to the Residency about 8:00 a.m. and in a few minutes I go out to Charter's office.

He gives me another lecture on cacao based partly upon his recent paper in the 1953 proceedings of the Cacao Conference in London (q.v.). Most cacao is planted under virgin or good second-growth forest. This forest is disappearing in the Gold Coast at the rate of about 700 square miles per year. Soon, say within 8 to 10 years, there will be no virgin or no good second-growth forest remaining for cacao plantings. This means that if the Gold Coast is to remain an important source of cacao, farmers must learn to grow the crop without needing virgin forest to begin with. Charter says that it is all very well to control the cacao diseases and insects, but the farmers must do much more than that and must learn to manage the crop for high yields. In fact, he observes, it takes high yields in order to pay for disease and insect control.

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He again explains the nature of the 3-story tropical rain forest and how the lower story is replaced by cacao and the canopy thinned. (See: The tropical rain forest: an ecological study by P. W. Richards. 450 pp. illus. Cambridge University Press, 1952). Charter then goes on to discuss the great problem of organizing and controlling native cacao production, which is very difficult with so many tiny individual farms. Yet diseases can be controlled only with good organization. Although the peasants are encouraged to plant the crop in straight rows, or on curved lines on the contour, very few of them use sprays. Charter feels that recommendations for using a bucket and brush to apply pesticides is wholly unrealistic.

He emphasizes that all soil scientists concerned with cacao are backward in their knowledge of its nutritional requirements and that there is not anywhere in the world a proved practical fertilizer scheme for the crop. He says that unless suitable agricultural methods are developed cacao production will fall rapidly as soon as the forests are gone, say sometime between 1960 and 1980. He tells me that production is now at about 240,000 long tons of beans per year. At the present time the exploitation of new forests is about replacing stands that are dying out. This production climbed from the beginning in 1890 to about its present level a little before 1940.

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We then go into the soil museum. First of all, Charter gives me the following summary of the relationship of soils to cacao use:

"Soils Used for Cacao Cultivation

129 profiles of upland forest soils ("rubrosols" in C. F. Charter's system of classification) analyzed in the laboratory were grouped in the following five classes:

1. Neutral forest soils: pH of the humus horizon (average thickness 8 3/4 inches) 6 to 7 (60 profiles).

1a. Forest soils with neutral reaction (pH above 6) in the surface horizon (2 to 3 inches), but with an abrupt decrease of pH (below 5) in the lower part of the humus horizon (8 profiles).

2. Intermediate-acid forest soils, where the average surface horizon of 2 to 3 inches has a reaction of pH 5.6 to 5.9, while the lower humus horizon has the pH from 5 to 5.9. (15 profiles).

3. Intermediate forest soils with a reaction of pH 5.0 to 5.5 in the humus horizon (19 profiles).

4. Acid forest soils, pH of surface horizon below 5.

Examination of the vegetation records yielded the following table:

Class	Number of profiles	Under cacao (No.)	Cultivation Percent
1	60	30	50.0
1a	8	2	25.0
2	15	2	13.3
3	19	2	10.5
4	27	none	nil

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The profiles are randomly selected and cover the following areas:

Ayensu Basin
Tafe
Akwapimian range
Banana areas (central part of the Gold Coast)
Upper Tano Basin

No laboratory data are available for the soils of the Kumasi region at the moment, but the pH data of the compilation (colorimetric) revealed the following distribution:

Soils under cacao examined	31	
Group 1	20	64.5 percent
Group 2	7	22.6 "
Group 3	3	9.7 "
Group 4	1	3.2 "

Department of Soil and Land-Use
Survey, Gold Coast, 1954"

I note his suggestion of "rubrosol" for Latosol. I note further that in his classification Charter gives great emphasis to the pH profile. He goes over the groups rather rapidly as follows:

I. Climatophytic (zonal) soils

1. Acid forest soils.

He shows me the profile samples of 6 soil series in this group. They have quite different colors and other morphological features but similar analytical data. The organic carbon is high and extends quite deeply. One of the soils in this group with a beautiful red color is developed from old drift in the uplands. Four of the others are more nearly yellow than red.

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One he calls a "drainage groove" soil. He explains that as a small stream valley begins with seepage water and colluvium from the upper slopes, two different kinds of soil are formed, one reasonably well drained in the upper part and another imperfectly drained in the lower part. A typical profile is somewhat as follows: 2 to 3 inches of medium-gray soil underlain with light-gray to about 12 to 15 inches. This is followed by yellowish soil lying above the stone-line at around 31 inches. Beneath the stone-line is mottled rotten rock which gradually gives way to the hard rock, which is commonly granite. These soils occur in intricately curving marginal strips between the brownish-red upland and the poorly drained sands and clays of the lowlands near the stream. The soils in this general group (1) are not productive of cacao.

(This whole discussion and explanation takes an enormous amount of ordering from his staff for the various samples, maps, books, and papers required to illustrate the points as he goes along).

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He classifies these in accordance with the principal local factor, such as "topographic" - his division for Planosols, depression soils, and peat.

After going over these samples we then all have lunch again chez de Endrey. Afterwards, we return to the museum and Charter goes rapidly over units used in the soil classification. In the detailed soil classification they establish soil series in about the same manner as we do in the American soil survey. The subdivisions of the soil series are handled somewhat differently. He uses "soil sub-series" to indicate lesser groups according to texture, stoniness, natural accumulations of silt, presence of iron gravel, etc. He uses phases for what he calls "accumulated" characteristics, such as those associated with the encroachment of a savanna on forested soil and truncation by erosion.

Charter then explains several definitions that he uses for kinds of soil associations. I think he has developed a good idea although I am not sure that I have captured all of his definitions accurately. Some of these follow:

Conscoceation: One soil series is dominant.

Simple soil association: Two or more soils occur in a regular sequence as, for example, one red or yellow soil of the uplands and another red or yellow soil on the slope over the same kind of parent material.

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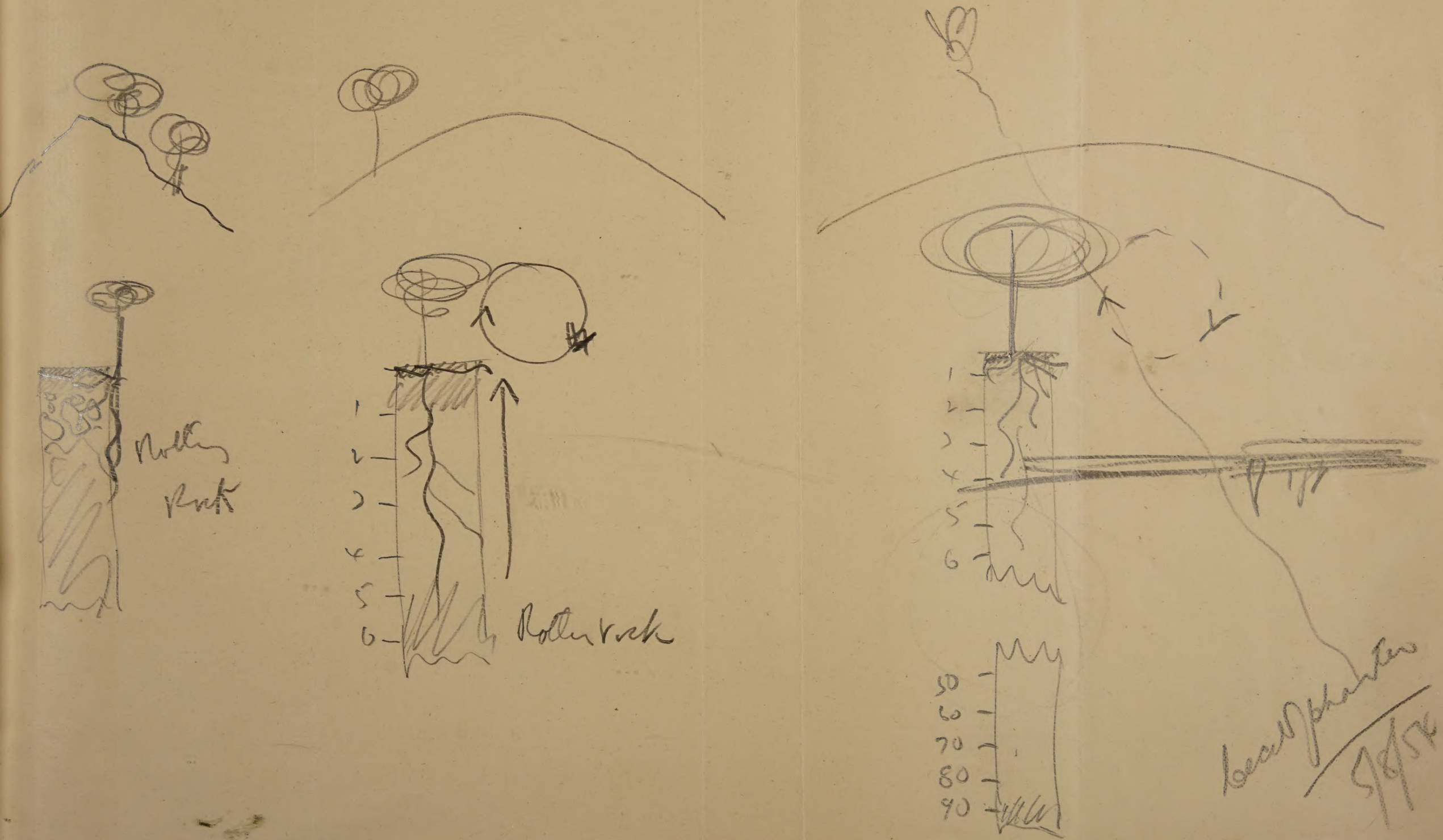
Rolling Rock
1
2
3
4
5
6
Rolling rock
1
2
3
4
5
6
50
60
70
80
90
Leaf photos
9/8/54

Acid Humus Rubrosols

Red

Yellow.

Red Top soil Group.

Grey brown Top soil Group

ditto

Sedentary

Ancient drifts

Contemp. drifts

ditto

Topo-hydr~~ogenic~~ic soils

Depression soils —  H. acid Glei | acid Glei | Wiesenboden | Vlei | Solonchaks

Planosols — ? G.W. Podzol - G.W. Laterite - Neutral Planosol - Ca Planosols - Na Planosols

Cumulose soils —  V acid Peat | acid Peat | Neutral Peat - Calc Peat - Saline Peat

Very Provisional

86

Compound association: The mapping unit consists of a simple upland association and a simple valley association.

Complex association: Two associations on different rocks occur within the mapping unit, such as associations of soils from soft rocks intermingled with an association from hard rocks.

Soil complex: Charter uses this for what he calls accidental soil groups such as, for example, intimately intermingled associations from schists, granites, and other rocks.

This discussion, illustrated by maps and many drawings, is followed by an explanation, chiefly by Mr. Brammer, of the soils of the Accra Plain, which I am to see later on this week. There is said to be about 1,500 square miles in this area lying between the western mountains, formed from old rocks up to about 1,500 feet elevation, and the sea. But most of the Plain lies below 250 feet and has slopes of only about 2 percent. Most of this low undulating Plain is underlain by crystalline rocks, unrelated to the present delta of the Volta River. These rocks include: (1) metamorphic basic rocks; (2) metamorphic acidic rocks; and (3) some Tertiary sands. In addition, there is some aluminum up to two miles along the Volta River and in its delta. This delta contains some old salty lagoons. Geologically Brammer regards the main part of the Accra Plain as an old dissected peneplain.

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The rainfall is unreliable. At Accra the annual average is 25 inches but this varies between 10 and 50. The rainfall is somewhat higher in the northern part of the Plain. The rainfall pattern gives two wet seasons and two dry seasons each year. Mountains in the west are forested and there is thicket on the slopes to the Plain. But most of the area is grassland with only a few trees. He found neutral forest soils in the mountains. The areas are small and are near the base of the slopes. Much of the soil in this part is lithosolic over quartzite and phyllite.

Soils of the Tropical Black Clay group over basic gneisses and similar rocks are very important. They commonly have 3 to 4 feet of soil material rich in montmorillonite. Although these soils crack, there is little or no gilgai. They are neutral in the surface and about pH 8.5 in the lower part. Commonly, an horizon of $CaCO_3$ accumulation is found below 18 inches. At around 3 to 4 feet the soil changes to slightly weathered rock.

In the lowlands associated with the Tropical Black Clays are "vlei" soils, which are somewhat heavier and even more cloddy and sticky. These are moderately acid in the surface to 18 inches; but the pH gradually increases in depth until one finds free lime at around 30 to 36 inches. The soils are subject to temporary flooding. The total acreage is small.

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Solonetzic Planosols with very gentle slopes are also to be found.

Brammer hurriedly describes some alluvial soils and red loams from the Tertiary sands. He thinks that the Tropical Black Clays are the most promising for farming under irrigation. He shows me detailed soil maps of sample areas. I notice some parts have hard rock within 30 inches of the surface. These might lose water rapidly. Charter and Brammer point out that advisors from the Anglo-Egyptian Sudan have suggested development into 5-acre peasant farms, and that the experimental work could be carried on at the same time as the land development. But Gold Coast farmers have had no experience with irrigation or with organized farming of any sort.

Charter and his group are recommending that the experimental work be followed by development in large estates. For the Tropical Black Clays they suggest: paddy rice, sugarcane, cotton, tobacco, small grains, sorghum, maize, pulses, and stock fodder. I think the estates should also have cattle but they can see no prospect for improving animal husbandry in the Gold Coast by traditional methods; yet with estates ranching could be successful.

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Aug 5

Aug. 5, 1934

Very Professional

1. CLIMATOPHYTIC.

O 1. Acid humus R-soils.

O 2. Medium humus R-soils.

O 3. Low-humus R-soils.

2. TOPOHYDRIC SOILS. = Intrazonal.

- 4. High acid gley.)
O 5. Acid gley)
O 6. Wiesenboden.) HYDROSOLS.
O 7. Vlei. = Ca-Solonchak)
O 8. Solonechaks.)

- 9. Ground-water podsols.)
O 10. Acid planosols.)
O 11. Ground-water laterite.) PLANOSOLS.
O 12. Neutral planosols.)
O 13. Ca-planosols. (nigrosols))
O 14. Sodium peat.)

- 15. Acid peat.)
- 16. Neutral peat.) CUMULOSOLS.
17. Calcareous peat.)
O 18. Saline peat.)

3. CHRONOLITHIC SOILS.

19. Rendzina.

O 20. Basimorphic soils.

O 21. Lithosols.

O 22. Regosols.

O 23. Alluvial soils.

Charter gives me some papers giving more detail about the work here and a copy of his detailed recommendations under the title, Estate agriculture and the integration of peasant farming, May 1954. (See Appendix 1-5)

We then go chez de Endrey for tea and further discussion. I return to the Residency in time for cocktails to meet several of the people directing other lines of work in the Ashanti district. The guests include:

Mr. Smith, Assistant Director of Agriculture, and wife
Mr. Duff, Conservator of Forests, and wife
Mr. Davis, Assistant to Mr. Gass, and wife
Mr. Barnesley, a geologist
Mr. Lilly, in charge of water development
Mr. Silk, in charge of agricultural training

I have a short discussion with each of these people about his work.

About 8:30 p.m. Mr. Gass and I have dinner. After a little chitchat with him about the organization of the Colonial Service and some of the problems in the Gold Coast, I go to bed.

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August 6

I am up at 5:00 a.m. for an early breakfast and packing since this promises to be a very long day. I leave with Mr. Brammer at 7:00 a.m. for Accra by way of Cape Coast.

As we drive out of Kumasi I note many patches of sugar-cane for chewing, in the low places. The roads are full of peasant women carrying food, fuel, and water on their heads. The soils are Red Latosols mostly from old rocks. Maize, cassava, and bananas are common. Although this area is said to have had a great deal of cacao, a large part has died out.

A few miles south of Kumasi we stop to look at a yellow soil on the slope. Except for mottling in the lower part there is not much horizon differentiation. The soil now has a heavy, second-growth of bush and I should think that pine-apples would do all right here. I see a few spots of cacao as we walk up the slope. The soil becomes red. Brammer points out that this area is a characteristic compound association of both well drained and poorly drained soils from the colluvial material and of both red and yellow soils from schist on the upland.

I take pictures of a neutral red forested soil from schist with fairly good cacao on the right and second-growth bush on the left.

August 6

I am up at 5:00 a.m. for an early breakfast and packing since this promises to be a very long day. I leave with Mr. Brammer at 7:00 a.m. for Accra by way of Cape Coast.

As we drive out of Kumasi I note many patches of sugar-cane for chewing, in the low places. The roads are full of peasant women carrying food, fuel, and water on their heads. The soils are Red Latosols mostly from old rocks. Maize, cassava, and bananas are common. Although this area is said to have had a great deal of cocoa, a large part has died out.

A few miles south of Kumasi we stop to look at a yellow soil on the slope. Except for mottling in the lower part there is not much horizon differentiation. The soil now has a heavy, second-growth of bush and I should think that pine-apples would do all right here. I see a few spots of cocoa as we walk up the slope. The soil becomes red. Brammer points out that this area is a characteristic compound association of both well drained and poorly drained soils from the colluvial material and of both red and yellow soils from schist on the upland.

I take pictures of a neutral red forested soil from schist with fairly good cocoa on the right and second-growth bush on the left.

K-2206 Aug. 6, 1954. Gold Coast. About 10 miles north of Bekwai. View into cacao along trail. Red Latosol (neutral forest red soil from schist). Cacao on right. Peasant carrying fire.

K-2207 Aug. 6, 1954. Gold Coast. A little south of Bekwai. Upland rice growing in relatively moist place.

K-2206 Aug. 6, 1954. Gold Coast. About 10 miles north of Bekwai. View into cacao along trail. Red latosol (neutral forest red soil from schist). Cacao on right. Peasant carrying fire.

K-2207 Aug. 6, 1954. Gold Coast. A little south of Bekwai. Upland rice growing in relatively moist place.

We see a peasant coming along carrying fire in a piece of wood, presumably to the market.

Further on we stop to look at a soil called Nta, which is a gray, massive, porous, loamy coarse sandy soil from granite. The very surface is grayish-brown.

We drive on through Bekwai. Brammer explains that polygamy is very common in this humid forested area. Since there are no high protein foods suitable for babies, a child cannot be weaned until he is about 3 years old. Thus, to have a continuous rotation, peasants who can afford them have four wives.

He explains that the cacao farmers will not take checks or paper money - only coin. Some return from the market with great boxes filled with coins that they apparently bury for safe keeping in their gardens.

A little south of Bekwai I photograph an interesting field of upland rice growing in the low ground under widely spaced trees.

As we return to the car I see a migrating stream of driver ants. They are highly organized, with soldier ants along the sides to protect and to guide the main stream (K2209). As I break this main stream with a stick, the mass of ants pile up like water in front of a dam; but within two or three minutes the soldier ants have them all corralled and the pilgrimage goes forward as before.

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K-2208 Aug. 6, 1954. Gold Coast. A little south of Bekwai. Upland rice growing in relatively moist place. Another view with Brammer.

K-2209 Aug. 6, 1954. Gold Coast. A little south of Bekwai. Driver ants on pilgrimage over road cut. Note soldier ants at margin.

K-2208 Aug. 6, 1954. Gold Coast. A little south of Bekwai. Upland rice growing in relatively moist place. Another view with Brammer.

K-2209 Aug. 6, 1954. Gold Coast. A little south of Bekwai. Driver ants on pilgrimage over road cut. Note soldier ants at margin.

Just before Asokwa, we pass through low, second-growth forests on basaltic hills. Much of this is old cacao land with a fair percentage in food crops and the rest in bush fallow. I see nice patches of umbrella trees on the more basic soils. As we move into fertile, rolling country it looks like rain even though we are supposed to have a dry season now. There is still some cacao in the fairly well drained areas. I suspect here that the big trees help keep the soils in proper moisture for cacao. The soils are mainly Red and Yellow Latosols.

The villages along here are quite neat. Some cacao and some opportunity to work on the highway give the people plenty of money since food crops are easily raised. I note here in the Gold Coast that the country men wear the brightly-colored robes as well as the women.

A few miles further on we pass by good cacao plantings under excellent shade. I am told that most of this area was essentially uninhabited until 50 years ago. Even yet there is not much pressure against the land. Rainfall is about 45 to 50 inches in this forest. This gives enough for crops without heavy leaching. Ground cover is dense and I see essentially no erosion. About the only erosion along here is in the paths of cleared land within the villages or at their margins.

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As we pass Atobiasi I see grayish-yellow soils from granite. The peasants have ample food crops and only a little poor cacao.

I stop in Prasu just a moment to take a picture of the market place.

All along the road here we meet and pass many "mammy lorries". These are 1-1/2 to 3-ton trucks with seats, which carry passengers and freight. They derive their name from the fact that most of the markets are operated by women who own these trucks. Nearly everyone of them has some dramatic slogan printed on the front. Some are from the Bible and others from less serious sources, such as "Watch that gal".

About two miles south of Prasu I stop to look at an excellent cacao planting. This cacao will run about 600 pounds of beans to the acre. With the present price it would be worth around $340 to the farmer. It was planted on a nice terrace of Red Latosol. Not many farms are so good as this one.

As we go along I notice that in the wet sites peasants are harvesting bamboo, which they sell to the fishermen for masts on their boats.

As we near Foso I see rather poor fields of cacao. The average rainfall has gone up to about 70 inches and the upland soils are orange-red rather than red.

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K-2210 Aug. 6, 1954. Gold Coast. Two miles south of Prasu. Excellent cacao on Red Latosol from old river terrace. This will yield about 600 pounds beans per acre. (Worth roughly $340 now). Brammer.

K-2211 Aug. 6, 1954. Gold Coast. Four miles northeast of Cape Coast. Cassava planting; alternating with thicket shown in the background (Brammer).

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K-2211 Aug. 6, 1954. Gold Coast. Four miles northeast of Cape Coast. Cassava planting; alternating with thicket shown in the background (Brammer).

After we pass Foso and go on south the rainfall begins to drop. It is said to be only 30 inches near the sea.

Around Teitee I see a few good groves of cacao as well as many poor ones. We are now getting into the older settled areas from which slaves were taken in the early days. I see some citrus plantings in the bush and a few groves of coconut palm. Within 13 miles of the sea we pass into anthropic thicket. Although only about 15 to 20 feet high these thickets are almost impenetrable. The land is used two or three years for cassava and then allowed to return to thicket for several years. The price of firewood is so high that the peasants get a fair income from the sale of the bundles of wood they get in clearing. Actually I think this is a bad practice because incorporation of this wood into the soil would do a lot to improve its productivity.

At noon we find ourselves on the margin of the sea in the town of Cape Coast. Here was the site of an old fort and the old iron cannon barrels that were scattered around are considerably eaten away with rust.

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After lunch we take the road to Accra. About 4 miles out of Cape Coast I try to photograph a characteristic cassava planting in association with the anthropic thicket. Besides cassava the peasants have small patches of maize and papaya with sugarcane for chewing in the low places. With continued overuse and removal of the woody part of the thicket, much of this cover is degrading from thicket to savanna. Near the coast there are odd patches of coconut palm.

We go through Saltpond and a little way north I try for pictures of a recent clearing with sticks piled for sale, new plantings of cassava or bananas, and old stands in background. Although oil palm is not grown commercially, I notice that the wild ones are protected and the nuts harvested for home use. Along here there are also good sized termite mounds. The soils are mainly clayey Red Latosols. I photograph an undressed profile of Red Latosol from schist, where both the stone-line and the quartz veins are prominent. The road leads us back into the forested country where bananas and cassava plantings look good. I get a chance to photograph an excellent mixed culture of bananas, coco-yams, and papaya, with "screw pine" (Dracena) in the background. As we go on I see more cacao farms. Some of the plantings are quite good.

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K-2212 Aug. 6, 1954. Gold Coast. Eight miles north of Saltpond. Young planted bananas and new cassava. When clearing thicket left native oil palm. Characteristic termite mound. Nearly mature banana and cassava in the background. Yellowish clayey soil on lower slope of Red Latosol from schist.

K-2213 Aug. 6, 1954. Gold Coast. Eight miles north of Saltpond. Undressed profile of Red Latosol from schist with quartz veins. A stone-line marks the top of the residual material.

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K-2213 Aug. 6, 1954. Gold Coast. Eight miles north of Saltpond. Undressed profile of Red Latosol from schist with quartz veins. A stone-line marks the top of the residual material.

K-2214 Aug. 6, 1954. Gold Coast. About 12 miles north of Saltpond. A mixed culture of bananas, coco-yams, and papaya growing well with Dracena (locally called "screw pine") in background. Good culture.

K-221b Aug. 6, 1954. Gold Coast. About 12 miles north of Saltpond. A mixed culture of bananas, coco-yams, and papaya growing well with Dracena (locally called "screw pine") in background. Good culture.

We pass Esiam and Bobikuma and a little after 3 o'clock we take petrol at Swedru, which is a large shopping center and a market town for cacao.

Beyond Swedru the intensity of cultivation increases - I think beyond what the soil should have. Still some of the cacao without shade looks fair.

As we approach Accra we come again to anthropic savanna with a few remnants of rather small canopy trees. As we approach the city we drive through the new university site. I am taken to Government House, or Christiansborg Castle, where I am to stay for the remainder of my visit as the guest of Sir Charles Arden-Clarke and his lady.

I am given a beautiful large room overlooking the sea. The surf roars continuously. The boy brings me tea and I excuse myself to Mr. Hamilton, the Governor's Aide-de-Camp, from cocktails in order to get a little rest.

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I am given a beautiful large room overlooking the sea. The surf roars continuously. The boy brings me tea and I excuse myself to Mr. Hamilton, the Governor's Aide-de-Camp, from cocktails in order to get a little rest.

The trip today through the forested area, the anthropic thicket, and finally to the anthropic savanna near Accra, was "out of the book." The trip was long and hard because of the small English car over bumpy country roads. I did not describe the soil profiles in detail mainly because of the lack of time and also because those that I saw conformed well to Charter's explanations of yesterday. This rapid reduction of the forests worries me. There is essentially no erosion now, except that along foot trails in a few villages, beyond some of the small clearings on very steep slopes. All the accelerated erosion I saw in over 200 miles could be found on one small Georgia farm. Yet with anything approaching mechanized farming as practiced in the United States or western Europe the soils would suffer. With crops in rotation, I believe that erosion would be devastating, especially on soils from granite; but all of the soils would suffer. I am convinced that in the present state of our agricultural knowledge these soils should not be plowed and should be placed frequently under tree fallows, certainly often enough to prevent the encroachment of savanna and, preferably, often enough to get the good tree species, like the umbrella tree, rather than thicket. I also note that farmers are cutting up all the wood above 1-1/2 inches in diameter taken from their fallows to sell for firewood, especially near Accra, as well as the larger trees. (The Gold Coast has no coal). This harvesting of the wood also

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lowers the base status of the soils and diminishes the effects of regeneration through forest fallow. With any present practices in use it is very hard to raise the base status once it has been seriously lowered. Experiments with fertilizer in mixed cultures of food crops and with cacao should be laid down at once. But the experiments should probably not be after the European manner for annual crops. They need to be based on a careful study of the basic principles of the forest-fallow system.

I think the soils of the area I drove over today are definitely on the edge. They can be maintained and improved; or they could go down very rapidly.

The villages are a few notches above those in the Congo. Houses are rectangular, usually with mud-block walls. Some of them have thatched roofs. Generally, the villages are very clean, but sanitation varied widely, perhaps partly with the personality of the local chief.

There are many goats, hairy sheep, and chickens in the villages. I see no scattered farms. One sees lots of vultures; these are not killed because they keep the villages clean.

As in the Congo, the women carry very heavy loads of water, firewood, and cassava and other foods on their heads. Men work on the road and in the bush, but carry few loads. Many of the men seem to work but little.

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On the whole, nutrition did not seem to be too bad; but the somewhat extended bellies of the naked boys suggest that their diets are too rich in carbohydrates. Apparently the natives have plenty of food, but not enough protein and not enough protective foods. Near the sea there are citrus and fish. Likely the diets here are better than under the canopy forests except for those who can and do buy meat, fish, and peanuts with money received for cacao.

Cacao prices are high now, and I wonder whether it is a good thing. Peasant farmers may have an unusual amount of money for the work they actually do. Unless the farmers improve their practices, cacao will decline in a few years when they run out of good canopy forest to exploit. And with the high prices, production in other countries will likely increase. Then things could get very tough in relation to the present income of the peasants for the work they do.

I am told that education is very popular in the Gold Coast. (How funny it looks to see a little black girl going to school with a tiny bottle of ink on the top of her head). But I am told that essentially none of the educated ones go back to their agricultural villages. For cities like Kumasi, and especially Accra, without industry, such growth could be bad. If the new hydro-electric scheme on the Volta River for aluminum manufacture becomes a reality, alternative employment may be available.

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Yet this is still a primitive country. I am told that ritual murders are yet a problem, and that human heads still bring 200 pounds sterling in some areas.

About 8:00 p.m. I have dinner with the Governor and his lady. They are very charming people. They have that rare ability to make a country boy like me feel that he amounts to something! After an hour's chitchat about British colonial problems and related subjects, the lady allows me to retire at 10:00 p.m.

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August 7

Up at 5:30 a.m. with the dawn and the roaring surf. The boy brings me tea and then breakfast. I write letters until time to go into the field. A little before 8:00 a.m. Tom Mead and Mr. Brammer call and we go to the Nungwa Experimental Station about 18 miles northeast of Accra. (See 1954 Guide in Appendix, item 6). Although this started primarily as an animal health farm the soils people at the University have a part of it for experiments. At the station I meet several of the workers as follows:

S. Smuts, soil conservation
F. Hagenzieker, soil chemist
R. F. Loxton, soil and land use
R. Rose-Innes, grassland ecology
E. Peacock, research fellow
P. R. Hill, farm manager

Mr. Hagenzieker, a former student of Edelman, begins to show me the fertilizer work. He explains a soil map he has made, which is not yet correlated with Mr. Brammer's map. In the laboratory he shows me samples of one of their difficult soils. This has a sandy surface soil with a heavy clay B horizon overlying acid schist. He also shows me a brown equivalent of the Black Cotton soil (or Tropical Black Clay). The laboratory samples have some inherited lateritic concretions and some calcium carbonate concretions. I am told that calcium carbonate is very irregular in the surface soil. Here everything has to be done in a hurry since I am supposed to meet several people in town before lunch.

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K-2215 Aug. 7, 1954. Gold Coast. Nungwa Station. View of plot layout for studying spacing of cassava and time of planting. Soil sandy with clayey B.

K-2216. Aug. 7, 1954. Gold Coast. Nungwa Station. Experience with grain sorghum showing the large effect of phosphorus. Sandy soil with clayey B.

K-2215 Aug. 7, 1954. Gold Coast. Nungua Station. View of plot layout for studying spacing of cassava and time of planting. Soil sandy with clayey B.

K-2216. Aug. 7, 1954. Gold Coast. Nungua Station. Experience with grain sorghum showing the large effect of phosphorus. Sandy soil with clayey B.

We go out to an area of Tropical Black Clay where the grass is being cut. Here the soil has a mild expression of gilgai with low mounds about 8 inches above the lowest spots between. These are somewhat elongated. The soil has also a fine micro-relief due to the grass tussocks. I am told that they get good responses from nitrogen but not from phosphorus alone. Nitrogen and phosphorus together give a greater response than nitrogen alone.

We walk over to the sandy soil with a heavy B horizon. Here I see cassava spacing experiments combined with variations of dates of planting. They are trying growing periods of 8, 12, 16, and 20 months with different planting dates and various populations. The row width is 36 inches and distances between plants within the rows are 16 inches, 26 inches, and 36 inches. (I wonder how many spacing experiments have been done on cassava!). Within the experimental plots there exists considerable range in the thickness and character of the surface soil. For these experiments 2 hundred weight (220 lbs.) per acre of each, superphosphate and sulphate of ammonia, are being used. I am told that fertility trials show good effects from nitrogen and especially from nitrogen plus manure. I note a marked effect where the old termite mounds have been leveled and spread around over the surface soil.

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Obviously this soil erodes very easily even with 2 percent slopes. Yet in the wet season drainage is a serious problem. I am not satisfied that ordinary earth terraces will be sufficient. I think they shall need to be covered with grass and have grassed waterways.

We step over to experiments on grain sorghum. Never have I seen a better demonstration of extreme phosphorus deficiency. Without phosphorus the plants are only 6 or 7 inches high and have characteristic purplish leaves. Without phosphorus there is little or no response to nitrogen. The best yields are obtained with nitrogen and phosphorus. Where adequately fertilized the grain sorghum is about shoulder high or more and well headed. I see similar results as those had with sorghum in the millet trials.

I look at a few cotton trials. The plants are small, but do not look too bad considering the uncorrected phosphorus deficiency. I think cotton would be possible here if the soil were properly fertilized, terraced, and drained where needed; and if insects can be controlled through large-scale dusting.

Obviously this soil erodes very easily even with 2 percent slope. Yet in the wet season drainage is a serious problem. I am not satisfied that ordinary earth terraces will be sufficient. I think they shall need to be covered with grass and have grassed waterways.

We step over to experiments on grain sorghum. Never have I seen a better demonstration of extreme phosphorus deficiency. Without phosphorus the plants are only 6 or 7 inches high and have characteristic purplish leaves. Without phosphorus there is little or no response to nitrogen. The best yields are obtained with nitrogen and phosphorus. Where adequately fertilized the grain sorghum is about shoulder high or more and well headed. I see similar results as those had with sorghum in the millet trials.

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I then go over to a field of this sandy soil over clay with some clayey patches to see new broad-based terraces. Channels are about 26 inches wide. At the upper end of the terrace the slope is about 1 to 500 while at about 900 feet further down, near the end, it is about 1 to 400. They are using ordinary tillage equipment with tractors. The first job in land preparation is to spread out these termite mounds, which are 3 to 7 feet high and number about one to three per acre. In order to build terraces it is absolutely necessary that these be completely planed away.

I am hustled to the car and taken to call upon Richard Fischer, the American Consul in Accra. He tells me that he should like to have a copy of any report that I might give the Gold Coast people! He also agrees to send back a sample of calcium carbonate from the "odum" tree.

I then make a short visit to Mr. J. E. Jantuah, Minister of Agriculture. Of course, he is a native resident. He is rather new on the job. Since an appointment has been made with the Prime Minister we do little more than exchange a few pleasantries.

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Next I go with Mr. Mead to see Dr. Nkrumah, the Prime Minister. We have a short interesting session and discuss the growing need for a fertilizer plant as a part of the Volta River Scheme. We discuss cacao farming, the problems of mechanization, and several other items. He makes three requests that almost amount to demands: (1) That I attend a cocktail party he is giving this evening for members of the Assembly; (2) that I come back for a longer conference; and (3) that I give some written summary of my suggestions.

Mr. Mead and I then call on Commander Jackson, who has the principal responsibility for heading up the planning of the Volta River Scheme. He and Mead explain to me how easy it would have been for the Prime Minister to have curried favor with his political friends, the cacao farmers, by allowing the price of cacao to rise by reduction in the export taxes, or rather by not raising them with the rise in world cacao prices. Of course, if the internal price of cacao should rise, the Gold Coast would have serious inflation and an ultimate economic crash with none of the great public works now being built with the tax revenues. They agree that the old British Government could not have withstood the pressure, but that this native one has done so.

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We then have quite a discussion about the Volta River Scheme and what is planned. Among other points, Commander Jackson is interested in planning to have completely air-conditioned homes for the European staff. He says, and I agree that one of the big problems for Europeans in the Tropics is that the women have too little to do so they sit around in the heat feeling sorry for themselves. He proposes to examine the wives of the engineers and other specialists as well as the men themselves and take only those whose wives have some interesting things that they themselves do: nursing, painting, writing, or something of that sort. Then with the air conditioned homes they can do their own work in comfort as in Europe. He thinks this will lead to improved community relationships.

At the conclusion of this conference I start for Kpong with Mr. Brammer, Mr. MacKinnen, and Mr. Linton at 12:30 p.m. (without lunch!). We stop under a kapoc tree for a picnic lunch about 33 miles north of Accra on the main Accra-Kpong road.

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They have about one square mile to begin with. They are now building their storage pond, which will be supplied by piping water from the river. Of course, the idea is to get the experimental work started well in advance of the general availability of water from the proposed dam. The first objective is to have a hundred acres under experimental control. The elevation here is about 40 to 90 feet. The soil is a characteristic Tropical Black Clay much like that recorded in my Mediterranean Journal for the area south of Algiers. The surface is black, heavy, sandy clay. The soil digs out in big masses friable with difficulty to medium angular blocky peds. The pH is about 6.5 to 7 in the surface. The surface soil gives way to somewhat heavier black clay beneath, which gives a reading on the color chart of 2/0. The pH at about 8 inches I measure as 8.0 to 8.5. There is a great deal of very sharp, rather coarse sand in the upper soil. The grains are little garnets. These may make some trouble with machinery. At about 18 inches the soil becomes very dark gray clay. This changes to light gray clay at about 3 feet through a transitional horizon mottled with grayish- and yellowish-brown. At around 40 to 48 inches, one reaches the weathered garnet-containing hornblende gneiss. The rock is rich in soda-lime feldspar and deficient in potassium.

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Upon exposure the A and B horizons break into angular blocks and later into smaller ones.

The soil is nearly level but not quite flat, I should say very, very gently undulating. Even here I notice a few black termite mounds from 3 to 5 feet high.

The present plan calls for open drains at 300 feet intervals. I feel certain that this will not be enough and suggest that they will probably find it necessary to have them not more than 100 feet apart. I also suggest that a few plots should be tried with overhead sprinkler irrigation. This might take less water and consequently avoid aggravating the drainage problem or the salt problem.

My guides are in a hurry so we leave around 3:30 p.m. by way of Akusa and Sonanya on the main road. Along here I see some little patches of Imperata cylindrica. Certainly they need to watch this.

In this area I notice that the little boys go naked until they are about 5 years old, but the little girls wear a small white cord and a very narrow, bright red crotch cloth.

On this road as yesterday, there are mammy lorries hauling people and freight.

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In this area I notice that the little boys go naked until they are about 5 years old, but the little girls wear a small white cord and a very narrow, bright red cotton cloth.

On this road as yesterday, there are many lorries hauling people and freight.

I am returning to the Castle about 5:20 p.m., just in time to change and go with the Governor and his lady to the Prime Minister's cocktail party. This is quite an experience. When we reach the big lawn the band plays "God Save the Queen" and everybody stands at attention while we get out of the car. I mingle with the people an hour or so and then Mr. Hamilton gets me and we return. The band playing is repeated as we leave.

We return to the Castle for dinner at 8:00 p.m. On the way home I tell the Governor that I now know how Cinderella felt. My host and hostess are very charming people. During and after dinner I have another useful lecture on Africa and the problems of administration.

Just before going to bed I try to collect my impressions from this very hurried day. The erosion problem on the soils like those at Nunga could become very serious indeed under clean cultivation because of the very uneven rainfall. Here there may be trouble with both poor drainage and soil wash during short heavy showers. The work seems to be well in hand provided the boys keep their minds open and do not become convinced of any set system until all the evidence is in.

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The Honourable the Prime Minister

requests the pleasure of the company of

Dr. C.E. Kellogg,

at a Reception for all Members of the Legislative Assembly constituted under the Gold Coast (Constitution) Order in Council, 1954, on Saturday, 7th August, 1954 at the King George V Memorial Hall

6.30 – 7.45 p m.

R.S.V.P. to the
Private Secretary
Prime Minister's Office

Dr. C.E. Kellogg,

Please present this card on arrival

I was impressed with the alertness of the Prime Minister. He seemed especially interested in following up my suggestion for a nitrogen fertilizer plant.

Commander Jackson as well as the Governor emphasized the need for starting the irrigation work on a small scale. The Governor said to me, "Doctor, recommend what you think is right; but please keep it small." Shades of the British Groundnut Scheme! It has thrown a scare into these men.

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August 8

Up at 5:30 a.m. and write letters. Yesterday was the first day I became really tired.

I start for the field at 7:00 a.m. with Brammer, Loxton, and Rose-Innes. We go east along the coast on the main road from Accra to Ada. We first stop to look at a deep railway cutting that exposes weathered schist, which had an uneven surface later covered with old sandy alluvium. The schists have prominent quartz veins and there is a gravelly line that marks the contact. Most of these gravel stones have an iron stain. The gravel layer is very irregular and doubtless conforms to an old erosion surface. The deeper places are filled with a yellowish-brown heavy clay. The surface soil has two to three inches of a medium gray-brown sandy soil; below the soil is brownish-yellow down to the gravel.

As we go along in the Plain I note red soils with red termite mounds on the higher swells. We drive off the road a bit to the station I visited yesterday in the hopes of getting a bit better picture of the gilgai relief on the Tropical Black Clay. But by the time I get there, there is not much more sun than yesterday. One of the boys gives me the name of the natural grass here: Veteveria fulvivarbis.

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K-2217 Aug. 8, 1954. Gold Coast. A bit east of Accra on road to Ada. Weathered schist, with uneven surface, covered with old sandy alluvium. Large quartz veins. Gravel at contact.

K-2218 Aug. 8, 1954. Gold Coast. Nungwa Station. View of surface of "Black Clay" to show mild gilgai.

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K-2218 Aug. 8, 1954. Gold Coast. Nungua Station. View of surface of "Black Clay" to show mild gilgai.

K-2219 Aug. 8, 1954. Gold Coast. Nungwa Station. A general view on the "Black Clay" with grass just cut.

K-2220 Aug. 8, 1954. Gold Coast. Nungwa Station. Micro-relief on Black Clay (about 8").

K-2221 Aug. 8, 195 . Gold Coast. 22 miles east of Accra on Ada Road. Nyigbenya soil series (in neutral savanna group). Drift of 3 inches to 3 feet over fairly hard laterite in the surface of weathered gneiss (?). Undulating plain. Note quartz veins.

K-2221 Aug. 8, 1955 . Gold Coast. 22 miles east of Accra on Ada Road. Nyigbenya soil series (in neutral savanna group). Drift of 3 inches to 3 feet over fairly hard laterite in the surface of weathered gneiss (?). Undulating plain. Note quartz veins.

We go on and stop at an outcrop in the Plain of pyroxene gneiss that gives rise to a dark reddish-brown light sandy clay having friable subangular blocky structure. Where deeper than 18 inches the soil has accumulated calcium carbonate. Areas of this soil rise in relief and drainage above the Tropical Black Clay of the Plain. In the center of this area is a slight dome made of rounded weathered boulders. Such domes are called a "Koppje" (or "little head"). The term is said to be from South Africa. I take a picture of the soil here with the reddish-brown sandy clay over very hard laterite within the old weathered gneiss. This soil is included with the Nyigbenya series of the neutral savanna group. The surface soil varies from three inches thick to three feet.

We continue on east through Dawhwenya and stop at about milepost 28 to look at the Tropical Black Clay in a very gently undulating landscape. We find an excellent exposure in a borrow pit along the road. A hurriedly written description is roughly as follows:

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K-2222 Aug. 8, 1954. Gold Coast. 28 miles east of Accra on the Ada Road. Profile of "Black Clay." Rotten garnet-containing hornblende gneiss at 30 inches.

K-2222 Aug. 8, 1954. Gold Coast. 28 miles east of Accra on the Ada Road. Profile of "Black Clay." Rotten garnet-containing hornblende gneiss at 30 inches.

A_1	0 - 9"±	Heavy, gritty, very dark clay. (10YR 3/1). Nearly massive. When dry, the soil cracks irregularly into a coarse, blocky structure. Most of the roots are in the upper 3 to 5 inches. The very surface 1/4 inch is a mulch of fine granular soil.
B	9 - 26"±4	Some of the cracks near the surface are about 1 to 2 inches across. The soil is very hard. I note a few rounded laterite concretions that have likely been added rather than formed in place. This grades into the next layer. This B horizon is a transitional B much like the soil above but more nearly black. The soil cracks into large aggregates of 1 to 3 inches, that are very hard.
B-C	26-31"±3	Transitional; limy; friable with difficulty.
C	31"+3-40+	Weathered rock material from garnet containing hornblende gneiss. The soil material is firm in place but friable. It is a mottled light gray, olive, dark gray, and olive-yellow coarse sandy clay rotten rock.

The cracking of the clay stops at the upper boundary of the C. The boundary between the solum and the rotten rock is abrupt. Except for the black color, the solum has a poorly expressed development of horizons. The pH is about 8.0 in the surface and about 8.5 below the B. All of the rounded lateritic concretions are in the A and B. I believe that most of the solum is developed from material like that in the C but not necessarily material that was weathered in the same exact spot.

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In places the profile is interrupted with V-shaped small veins of lateritic gravel. I suspect that these represent fills of old drainage channels. The surface is very gently undulating and the vegetation is mainly grass (Veteveria f.), with only a few scattered shrubs. As we walk over the surface I note an irregular, very thin pavement of small lateritic concretions and garnets of coarse sand size. There is very slight and irregular gilgai. I have no doubt there is some slight sheet wash during heavy storms that brings some fine soil material into the cracks. The cracks out in the plain are about 6 to 10 inches apart and 1/4 to 1 inch wide.

We drive on into the Plain and pass on to some more soils from acidic gneiss with sandy surfaces and heavy clay B horizons. Beyond this I stop again on an area of Tropical Black Clay where the soil is a bit heavier than the first example. The solum is a bit deeper and cracks up to 1½ inches across are common. Yet there is very faint, if any, gilgai. The grasses here grow in tussocks and these give the surface a fine micro-relief.

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K-2223 Aug. 8, 1954. Gold Coast. 28 miles east of Accra. Landscape of "Black Clay."

K-2224 Aug. 8, 1954. Gold Coast. About 30 miles east of Accra. Cracked surface of "Black Clay."

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At mile post 41 1/2 from Accra I stop to look at the Agawtaw soil--a solonetzic Planosol. The surface is gently undulating. The vegetation is grass in tussocks with bare ground between. One of the main grasses is Monocymbium ceresiiformis.

A	0 - 8"	Nearly massive, friable, light olive-gray loamy sand (5Y 6/2).
B	8 - 20"	Abruptly the soil has changed to very dark grayish-brown clay with hard coarse prismatic structure that breaks into coarse angular blocky. The soil is mottled with shades.
B-C	20 - 24"	Massive plastic clay, olive-gray (5Y 5/2) mottled with adjacent colors.

The surface soil is said to be about pH 6.5 to 7. The B is somewhat more acid but the pH rises to about 8.0 in the lower part.

As usual we are in a big hurry and shall certainly be very late for Sunday lunch.

At mile post 55 we stop to take a quick look at a friable red soil (2.5YR 4/4) of sandy loam to loam texture from Tertiary sand. These undulating red soils appear to be several feet in depth. I walk back from the road and note that the surface soil is only slightly more brownish red than the disturbed lower soil of the road cut. Here I see some rather poor cassava under dry farming. Some of the local drifts here may be due to the long-time effect of the mound-building termites. I should think that these soils would be excellent for vegetable and fruit production under overhead irrigation.

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We drive out toward the sea over some nearly pure white sandy soils derived from these Tertiary sands, and out onto an old lagoon where the soil is only a little above the sea. This material is a brightly mottled clay with a good deal of medium sand in it. The flat landscape has many small saucer-shaped basins in it. These lagoon soils are placed in the Ada series, which includes the old alluvium of the delta. They are commonly salty in the lower part, but often extremely acid in the surface from the effects of ferrous sulphate. Thus the surface soil may have a pH of 5.5 with pH 3.5 at 12 inches and gypsum crystals beneath.

I now note that my companions have brought sandwiches which they take time to eat and this will make us still later in Accra. Finally we turn back and drive very rapidly along the road we came. I notice that we pass several small and a few large herds of small to medium-sized cattle. They look to be in good condition, which means that the dry grass is considerably more nutritious than one would suspect from its appearance.

We are back to Accra about 2:15 p.m. and I have lunch with Mr. and Mrs. Mead. This is followed by general talk about some of the agricultural problems of the Gold Coast. As I go on here, I become increasingly impressed with the judgment and vision of the top European officials.

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About 5:00 p.m. I return to the Castle in order to change from field clothes to go for cocktails with Commander Jackson and his wife. On the way up the steps to my room I meet the Governor and his lady. They are very curious about the contents of my field kit bag and I lay out all the things and explain their use.

Commander Jackson comes for me a little before 6:30 p.m. He is very rapid in speech and action. He covers the whole field of science, economics, and politics as related to the hydro-electric scheme. Although not unsure of himself, he recognizes the value of experts in their own line. Both he and his wife (who writes under the name of Barbara Ward in the New York Times and other American magazines) are ardent New Dealers, even though otherwise British. Both know America well. Commander Jackson worked closely with both LaGuardia and Lehman during UNRRA days. I'm back to the Castle at 7:50 p.m.

During and afterwards I have another very interesting lecture from Sir Charles on his long experience with Africans. One statement is certainly worth noting: He says, "The Africans are far less ruthless than we are." He explains that this is why they lost at least some of their military engagements with the Europeans.

I am becoming increasingly impressed with the Governor. He is patient, wise, kind, and <u>firm</u>. Certainly I should hate to be against him on a really fundamental point.

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August 9

I'm up at 6:00 a.m. We leave about 7:20 a.m. for a visit to cacao farms. Brammer first takes me to the office of Mr. Brotch, who is in charge of the program for cutting out cacao trees affected with swollen shoot. He explains that they have an enormous problem of making detailed maps of the farms since no accurate cadastral surveys exist. The farms run from one to three acres in size, but one farmer may own several of these scattered about. The surveys are made by chain and compass and although not claimed to be accurate, apparently many people accept the lines for other purposes.

Legally most of the land is owned by the villages. This land is called "stool land." The stool on which the chief sits is the symbol of the village authority. To it the members of the village owe their allegiance rather than to the particular individual who is currently chief. But most of the cacao farmers actually hold their land in perpetuity. I raise the question about the possibility of getting these fragmental holdings brought together in solid pieces through reallocation. I'm told that because of the traditional background peasant farmers would oppose such a program very vigorously.

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In many places "stranger farmers" - farmers from outside the village - hold land as tenants but actually pay little of the rent they are supposed to pay to the village stool. Some of these "stranger farmers" are a bit worried about the mapping program because the village stool may catch up with them and demand fair returns. The "stranger farmer" wants the money himself that the Government pays for the cutting out of trees, but yet he feels that he will have more rent to pay.

The present staff on this important project amounts to 170 senior white and black officials; 3,000 field advisors who are literate; 300 to 400 draftsmen; and some 13,000 to 14,000 laborers. Since time is short we leave by car for a visit in the field near Aburi and Koforidua. Mr. Brotch feels that capsid is becoming a very serious problem although not yet so bad as swollen shoot. He explains that the Government markets all the cacao and takes nearly half of the proceeds in taxes, which are now being used to finance this program and many others. He explains that the agricultural laborer is now paid about 4 shillings per day (about 60 cents, USA).

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On the way we drive through an old government station for cacao at Aburi, which was established around 1870 as a botanical station. The first cacao plantings were made about 1879. We stop at the headquarters of Brotch's organization near the cacao station at Oyako in order that I might discuss agricultural problems with the local cacao farmers. Among those present is Kwame Poku, who is called the chief farmer - the leader of a farmers' union in the Gold Coast. Some of the group speak English and for the others Mr. Saakodee interprets for me.

They start out by complaining to me that the cutting out of trees infected with swollen shoot does little good. They say that the farmers are poor and that the compensation paid for the cut-out trees is too small. They also claim that the Government pays laborers 4 shillings a day and that farmers cannot afford to pay laborers so much. They insist that the Government should pay at least 8 shillings per tree, which would be about twice what they pay now.

I rather press some of the farmers about how much time they actually spend on their farms. They give me a story about this that I can hardly believe, saying that they go early and come back late 6 days a week. One fellow with 7 farms says that he goes to each farm twice a month and oversees the cutting out of the underbrush and the removal of black pods.

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Another complaint of the farmers is that the Government should cut out trees only after harvest since the swollen shoot does not affect the quality of the otherwise good pods. On and on they give me quite a bill of complaint. One tells me that the reason boys out of school do not come back to the villages is that they have no money to start farms and that the government should furnish it.

I smile at them about their claims of poverty and try to get across to them that farmers in many other countries are far poorer than they are. I also try to get across the idea that any government that does everything for them would be a dictatorship. I tell them that I had understood they wanted a democracy in the Gold Coast. They agree that they do. And I go on to tell them that the basic purpose of democracy is to make it possible for people to help themselves.

Through inquiry I press them very hard on what each of them do personally. I also press them with certain questions about what their farmers' union does. (Of course, I suspect that it is nothing more than an organization for griping and for requesting bigger subsidies from the Government). I then go on to explain what farm organizations do for themselves in the United States. They seem quite interested in this.

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They also suggest that farmers should have credit without interest. I protest this quite strongly and they finally admit that the interest rate should be at least 5 percent on Government loans. I understand that local interest rates among the natives may run to 10 times this much.

Obviously, these cacao farmers want a very easy living with little or no work. But then maybe they are not too different from other farmers and lots of other people in many other countries. On the whole we have a good visit. They want to have their pictures taken with me and so I set my camera and make a try.

We leave this group and go on to New Tafo. We are a little late so we have a picnic lunch while the local officer gets the farmers notified.

I do not get on so well with this group. It is very hard to get them to do much talking. I have the feeling that they are a bit suspicious of my motives in questioning them. The chief farmer of this district has some 49 acres in scattered holdings. I ask the group about the possibility of bringing these scattered holdings together into consolidated individual holdings. All of them say with emphasis, that such a scheme is impossible. These farmers also complain about prices. They insist that they should have 10 pounds sterling for 60 pounds of cacao beans. The chief farmer insists that he goes to his land 5 days out of each week to supervise four laborers.

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Here they get two shillings for a large tree that is cut out, and one-half shilling for a small tree. This rate is lower here because the area is one of the so-called "devastated areas." In other areas, not so heavily infested with swollen shoot, payment is twice as much.

These farmers insist that they should have more help to replant, and claim that replanted cacao does very well.

The chief farmer of the district says that he brings farmers together to explain the methods being followed. They have some 372 members. The farm organization he represents does no buying or selling. Everything goes through the local market.

I try to talk with them about the possibility of some other crops but they think there is nothing that can substitute for cacao.

The Government does not pay interest or give the farmer advances on his cacao. The local interest rate in the village runs about 50 percent. They tell me that it costs about 3 pounds sterling per year to send children to the local schools after 12 years of age. They say they need to buy maize, pepper, sugar-cane, and fish. They raise fowls, sheep, and pigs for their own use. All these farmers have some animals.

The farmers here all claim that they take out the black pods as soon as they appear. (I doubt this).

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K-2225 Aug. 9, 1954. Gold Coast. At Oyeko. Cacao farmers interviewed by Kellogg. At left of Kellogg (center) is the "Chief Farmer" of Gold Coast - Kwame Poku; at extreme right is Saakodee who interpreted for Kellogg.

K-2226 Aug. 9, 1954. Gold Coast. South of Tafo. Nine-year-old cacao following cut of swollen shoot.

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We leave to return to Accra about 1:30 p.m. and stop briefly to look at a few cacao farms on the way. I'm told there are about 600,000 to 700,000 cacao farms in the Gold Coast now.

I'm told that still in much of the Gold Coast the inheritance of property is through the female line.

As soon as I return to the Castle I change my clothes hurriedly and call on the Prime Minister with Mr. Mead. We go over several points together and he asks that I make a memo of these points to Mr. Mead.

Added later: This memo was prepared later on the basis of my notes made just before and after the meeting with the Prime Minister. They follow:

Washington 25, D. C.
September 28, 1954

Air Mail:

Mr. Tom Mead
Permanent Secretary
Ministry of Agriculture
Accra, Gold Coast

My dear Mr. Mead:

This letter is written at the request of Prime Minister Nkrumah as a memorandum of my discussions with you and others about the suggestions I threw out for consideration. You realize that in a week's time one can hardly arrive at anything approaching mature recommendations.

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First of all, I could scarcely over-emphasize how interesting my visit was in the Gold Coast. Certainly a great deal of useful and well-considered work is going forward under competent direction. I learned a great deal.

The main points that impressed me may be summarized as follows:

1. I think it highly desirable that the cutting-out of cacao trees suspected of the swollen shoot disease be strengthened. This includes not only the cutting out of trees having symptoms, but those suspected of the disease either because of tests of the leaves or because of their proximity to diseased trees. I think vigorous sanitation along this line will remain essential until such time as disease-resistant varieties may be found. I am told that prospects for such disease-resistant stocks are not good at the moment.

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2. I should like to urge consideration for the inclusion of a chemical plant for the manufacture of fertilizers as a significant part of the Volta River Scheme. It would be my present view that the chief plant nutrient needs in the Gold Coast are for phosphatic and nitrogen fertilizers. Without doubt as the agriculture develops and as the soils become adequately supplied with nitrogen and phosphorus, other plant nutrients will be needed; but certainly these two are the critical ones in the beginning. If nitrogen were the principal need, I should suggest an urea plant. This material is of high analysis and can be kept in good physical condition. Since there is an obvious need for soluble phosphatic fertilizers I should give first consideration to a nitrogen plant that would produce both ammonia and nitric acid. The nitric acid could be used to treat rock phosphate shipped in from overseas and could be combined with ammonia to produce ammonium nitrate. It is now possible to handle ammonium nitrate safely and effectively. In the Accra Plain there will be a large need for phosphatic fertilizers and for nitrogen. I think you will find need for both of them on many of the other soils as well. Then too, any excess production should find a ready market in other parts of tropical Africa.

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3. The need for greatly stepped up research on the nutritional requirements of cacao should be emphasized. As you know, most cacao plantings are now made on virgin forest land or under good second-growth forests. This cannot continue many more years. So far as I know no one seems to know precisely why cacao does not do well under other conditions. I suspect that soil fertility is a large part of the answer, although this probably is not all of it. Certainly on some soils the associated forest trees improve water relations. Their shade may also have an indirect affect on nitrogen fixation. I suspect that a large part of the beneficial influence of trees may be due to the fertilizing action of the leaf fall.

Soil fertility studies of tree crops are very difficult to conceive and to lay out. Successful experimentation will probably call for some large experimental plantings of the size commonly associated with an estate. Since my return, it has occurred to me that you might be able to secure some direct advice from Prof. Tom Wallace, Professor of Horticulture at the University of Bristol, and Director of the Long Ashton Station. He is one of the most competent authorities in this general field. Another excellent advisor would be Dr. M. Drosdoff of the Department of Agriculture, Gainesville, Florida. He worked out a highly successful research program for tung trees in the southern part of the United States and did a fine job on diagnosis of

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nutritional problems of coffee in Colombia. I should like to urge that consideration be given to having a thorough field study made by either Professor Wallace or Dr. Drosdoff, provided there is a prospect for a vigorous research undertaking.

4. I should call your attention to the great need for improving maize in the Gold Coast. Perhaps in my hurried visit I did not see fair samples. Anyway, I saw a lot of very poor maize. Since this can be a very important crop for the peasant farmers I believe it deserves more attention. As you know, I later made a visit in the Congo and near Yangambi I saw some excellent maize being grown by peasants. This maize was developed at the Yangambi station by crossing the native sorts with one having a great deal of rust resistance. Also, practical schemes of fertilization have been worked up. I think it would be worth your time to seek more specific suggestions on how this work was carried out from M. F. Jurion, Director General of INEAC, 12 rue aux Laines, Brussels, Belgium. I see no reason why you could not grow good maize in the Gold Coast.

5. I realize that you may have some difficulties with the irrigation of the black soils in the Accra Plain, but I don't feel that these are at all unsurmountable. As tropical black clays go, these soils are on the good side. I am sure your research officers realize the importance of being on the alert

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against harmful salts and against waterlogging. For continued successful cropping, fertilization with nitrogen and phosphorus is probably essential. If the insect hazards can be overcome, cotton ought to do well and I should think that sugarcane and rice could be grown. As a part of the experimental setup, I would recommend some experiments with overhead irrigation since that method requires somewhat less water, thus making it possible to avoid harmful salts and waterlogging a bit easier than with furrow irrigation. It might be that any differences you would discover would be too small to pay economically; but first you must have the physical facts.

On the road from Accra to Ada I observed an excellent red soil with a loam texture at about milepost 55. It is undulating and well drained. If water could be gotten to it economically, this soil should be an excellent one for fruit and vegetable production with overhead irrigation.

6. It seems to me that further consideration should be given to African oil palm of high quality. I realize that the humidity may not be ideal and that oil palm may not seem highly profitable just now with the high price of cacao. But still I should think that it could have a place in the more humid parts of the country, certainly for local needs.

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7. I should like to stress the danger of mechanical farming on the style practiced in western Europe and the United States. A great many of the soils in the forested part of the country would, I believe be very erosive under clean cultivation. Because so many experts are familiar with mechanical farming in the United States and because returning Gold Coast students will have seen it, I feel that your agriculturists shall need to guard against attempts at clean clearing. I feel sure that many of the soils would erode badly. In fact, it is clearly evident that erosion will be a major problem on some of the gently undulating soils of the Accra Plain like those observed at the Nungwa station.

8. The careful selection of Gold Coast students sent abroad needs great emphasis. Members of the Government must realize that each of these students is a kind of public ambassador of the Gold Coast to the university or institute where he goes. He should have enough mature judgment to be able to learn the fundamental principles that can be used within his own ecological and cultural setting at home. Few if any systems of farming, and not many individual farming techniques, can be transported bodily from the United States to the Gold Coast. Of course, the basic principles of engineering, plant growth, soil behavior, and so on can be transferred. Then these principles can be used in the invention or development of improved systems within the Gold Coast.

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9. I was considerably impressed with the excellent work of the Department of Soil and Land Use Survey. It seems to me that they have worked out a good administrative scheme for training and using local assistants, which helps train local citizens and also keeps costs as low as possible consistent with good work. Now is a good time to emphasize this work so that full advantage can be taken from the basic soil facts in planning the many public works and new agricultural programs. I believe it would be helpful if some additional work could be done in this Department that would permit carrying the interpretations on the agricultural potentialities of the soils a little bit further than they are now able to go. Toward that end, I should like to suggest that Mr. Charter have the opportunity to visit here in the United States.

I have no doubt that all of these suggestions have already been before you. If there is anything that I can do to help you, I should be glad to be called upon. Of course, you realize that some of these points I have listed fall in other fields of speciality than my own. If you do want me to follow up some of those with further recommendations of people to consult, I shall be glad to try to do so.

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K-2227 Aug. 9, 1954. Gold Coast. Accra. From the balcony of my room in the Castle.

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Mr. Mead then takes me back to the Castle where I start packing and have tea.

In the early evening just before dinner I have a pleasant chitchat with Mr. Hamilton, the Aide-de-Camp to the Governor, in his delightful bungalow by the sea. He has many books, records, paintings, objets d'art, including a very large painting of himself in oils.

I have another pleasant dinner, my last at the Castle. Then I am driven to Mr. Mead's house where I repack my baggage to include the things I had left with him. We have a pleasant discussion about the Gold Coast, as one day changes to another.

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August 10

About 1:30 a.m. Mr. Mead takes me to the air station. I go through immigration and customs and finally take the plane about 2:50 a.m. I'm down in Leopoldville at 7:35 a.m. which is 8:35 a.m. Leopoldville time. I'm met by Miss Latz of the Congress and by Mr. Yost of the American Consulate.

First I go to my hotel and get settled and then take a cab out to the meeting place of the Inter-African Soils Conference. I see Director-General Jurion, and many of the others at lunch. I am simply too tired to attend the meeting now, so I take the bus back to the hotel. I sleep very little because of the noise and get up at 6:30 for some tea and cake.

Leopoldville is growing enormously - apartments, office buildings, and other structures are going up everywhere. In fact, the city looks like one vast construction camp. Now near the end of the dry season there is a great deal of dust. Few of the gardens seem to be watered.

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INSTITUT GEOGRAPHIQUE
DU CONGO BELGE

LEOPOLDVILLE

500 0 500 1000 1500 m.

Fleuve Congo

Embarcadère vers Brazzaville
Port Public
Ciné Albertville
PALACE
B.N.C.I.
B.B.A.
B.C.B.
Musée de la vie Indigène
Cathédrale
TERMINUS
Ciné RAC
Flamingo
Socobanque
REGINA
MEMLING
Parc de la Résidence
Point de vue
Point de vue
Résidence du G.G.
Colonel Vangele
Lippens Avenue
Temple Protestant
Poste
Studio Information
Hôtel de ville
Miredo
Police
Ciné Palace
RESIDENCE
Avenue
Building Administratif
Salle Albert 1er
Valcke
Albert 1er
Laboratoire routier
Institut Géographique
Laboratoire
Hôpital
Ecole médicale
Jardin Botanique
Zoo
Marché
Armée du Salut
Lieutenant
Cercle Albert
Athénée Royal
Cercle de Léo.
Service et Musée géologiques
Restaurant du Zoo
Belgika
GUEST HOUSE SABENA
Hôpital
Galiema
Avenue
Boulevard
Avenue
Golf-Club
Petit Pont
Gombe
Baudouin
vers Matadi
Ecole St Luc
Cercle Hippique
Joséphine
Stade Reine Astrid
Prince
Aérogare
Ecoles Professionnelles
Aérodrome
Nguma
Camp militaire
Charlotte
Avenue
Funa-Club
Funa
vers Léo II
Stade Ermens
Volo
Stade Roi Baudouin
(Musée de Paléontologie)

Eglise Catholique
Temple Protestant
Excursion
Point d'intérêt géologique
Ligne d'autobus Athénée-ville
Arrêt

Mr. Kellogg

BUS SERVICE.

A regular bus service will operate during the Congress for members, and will run every hour between the town and the Athénée Royal when the Congress is being held.

A double service will run in the morning and at lunch time. The itinerary will be as follows :

Athénée, Albert College, Information, Central Post Office, Hotel Memling, Hotel Regina, Hotel Palace, Place Léopold, Central Post Office, Information, Albert College, Athénée.

The bus will leave from the Athénée at the following times :

Athénée : 7 - 7.30 - 8 - 8.30 - 9.30 a.m. - 12.30 - 1.30 - 2 - 2.30 - 3.30 - 4.30 - 5 - 5.30 - 6.30 - 7.30 - 8.30 - 9.30 - 10.30 - 11.30 p.m.

Coach for Visits and Excursions:

A special coach will be available for member taking part in the various visits and attending the functions organized for their benefit.

The coach will leave from the Athénée and, on its return, will call at the various hotels in town.

x x

x

August 11

Note: Between August 11 and 22 inclusive I attended the Inter-African Soils Conference, sponsored by the Committee for Technical Cooperation in Africa south of the Sahara, and the 5th International Congress of Soil Science. Since the proceedings of the Conference and of the Congress are being published, together with formal comments and with the actions of the Council, no attempt is made to include a full running account of these meetings.

In the early morning I have some talk with Tavernier about plans and arrangements for the congress, and then go out to the meeting place of the conference where the program is already under way.

Professor da Costa gives his paper on nomenclature of soils in the tropics. He recommends Latin names with connotations besides color. I agree with him and explain briefly that we have been thinking along the same lines. There is much discussion about "laterite." Some want the term limited to hard laterite only. Aubert and I want to include also the soft material that is subject to hardening and the concretionary laterite. (But I suspect that Aubert would go further than I and include within laterite what I call Earthy Latosol). Then some raise the old question of wanting a list of characteristics in the order of their importance. I give an explanation of the principle of integrated soil units and try to

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explain that one cannot make such a list for general application because the significance of any soil characteristic depends on the others in the combination.

A. M. Spurr then gives a paper on the classification of soils in the southern highlands of Tanganyika. He emphasizes the close relationship between geology and soils and especially the importance of geomorphology and erosion cycles. He says that only those soils from post-Pleistocene materials have catenary relationships to the present environment, including climate. He says that under the sub-humid climate in the highlands, the old tropical soils have had little modification. This is a useful paper. From the discussion of this paper and others I am delighted to see how much my Congo paper[1/] has stimulated soil research in Africa.

1/ An exploratory study of soil groups in the Belgian Congo. (with F. D. Davol) INEAC. Serie Scientifique No. 46. 74 pp. 1949)

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After lunch two or three papers are read by title only and Mr. Calton discusses an experimental soil map of Tanganyika. He suggests a series of catenas by age and relates them to (1) skeletal soils, (2) those dominated by montmorillonite, (3) those predominantly kaolin, and finally (4) those that are largely aluminum and iron oxides.

Then Aubert discusses his grouping of soils in French Africa. This is followed by a paper by one of Aubert's French associates, M. Lamouroux, on a soil map in Ogou-Mono and its relationship to land utilization. This is followed by a statement given by M. Gouveia about soil maps and their use in Mozambique. This is all rather sketchy. M. Riquier gives a statement about soil maps in Madagascar. Unfortunately, he has used one of the older systems started several years ago in the Soil Conservation Service, and I'm afraid it will not work out usefully.

M. D'Hoore, in his capacity as director of the Inter-African Soil Service, gives a summary statement about soil surveys and soil classification in Africa. This is followed by a discussion of how to organize useful regional committees or subcommittees that may give him competent advice for developing a common plan for a soil map of Africa south of the Sahara.

I have tea with several of the participants and return with Professor Tavernier and Dr. Ignatieff to my hotel. I have dinner with Ignatieff, Brammer, and Charter during which we have a good discussion about books. Early to bed.

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August 12

I'm out at the conference and first hear another paper by M. D'Hoore on the human factor in the exposure of the old horizon of sesquioxide accumulation. This gives Charter an opportunity to discuss the significance of geomorphology in the study of laterite. He says that soils are not simply 3-dimensional, they are 4-dimensional. Muir emphasizes that in the study of the reducing effect of organic acids on ferric oxide, the effects may be far greater in the light than in the dark.

The discussion of this paper takes us over the whole field of laterite formation, both formation in place and by accumulation through groundwater and through seepage. Since the discussion is in both French and English, and much of it very rapid, results are not too clear but infinitely better than would have been possible only 5 years ago.

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It is said that the silica in grass, when heated during hot savanna fires, becomes fused into fine grains. The resulting ash is moved by wind and water. D'Hoore thinks that surface soils, down to 30 centimeters, may lose much silica over several years from this process of removal by grasses, fire, and removal from the surface by wind or water. Fripiat says that under forest he finds 1 to 3 percent gibsite while in the upper 30 centimeters of soil there is often 20 percent under savanna with other conditions comparable.

After tea D'Hoore goes ahead with a paper by himself and others on the iron oxides fixed on tropical clays. He says that he regards 10 to 12 percent ferric oxide as an "optimum" value for tropical soils. M. Fripiat gives a paper on the cation exchange capacity of some soils in the Ruzzi Basin of the Congo. Mlle. Gastuche leads the discussion very well.

At noon Mr. Yost of the American Consulate comes for me and we go to a luncheon of the American Club at the Palace Hotel. This is a very pleasant affair but I need to leave a few minutes before it is over in order to take a boat for a visit to the geological and agricultural research laboratories for French Equatorial Africa in Brazzaville.

We walk through the various laboratories and Aubert shows me several soil maps of Central Africa.

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We are back at the hotel a little after 6 and I have dinner with Dr. Ignatieff and Prof. Tavernier. We have a long talk about the problems of soil correlation in western Europe and the coming meeting on this problem in Ghent during September. Tavernier feels that it may be difficult to get the Germans to cooperate on a uniform system of soil description and nomenclature as outlined in the Soil Survey Manual, to which others have all agreed.

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August 13

I'm up early and write my "thank-you" letters to the very pleasant people who entertained me in the Gold Coast.

Prof. Tavernier and I go out to the meetings in a car with M. Henrard. M. Maignien gives the first paper on laterite crust. Aubert says that the hardening of the laterite goes more rapidly in materials of sandy clay texture than in either sand or clay, other things being equal. Charter asserts that with rainfall above 900 mm. he finds no textural B horizons in the Gold Coast. Aubert says that he finds horizons of higher clay content produced through leaching of clay and iron oxide.

Mr. Vine gives an excellent paper on the Latosols of Nigeria in which he supports my definition and concept of this suborder. In the discussion there is a good deal of talk about the black soils of high mountains and their relationship to the Ando soils. I am a bit surprised that Muir suggests that low silica-sesquioxide ratio be omitted from the list of essential features of Latosols. Most do not agree with this suggestion. A paper is presented by M. Kuczarow on soils in Urundi. And M. Craene presents a paper on the fertility of Latosols and another on stone-lines. In this paper he presents the interesting and very improbable theory that these stone-lines are due to the

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recrystallization of silica in contrast to the common theory of stone-lines representing old erosion surfaces. In the discussion I mention some of the stone-lines in New Zealand, including those resulting from slips on steep slopes.

M. Kuczarow discusses the soils of Kaitega in Ruanda-Urundi. In the discussion period Charter describes an interesting railway cutting in an old peneplain with a rather deep stone-line parallel with the surface. The drift above the stone-line has buried an old termite mound within the base of which, and above the stone-line, are lime concretions.

Spurr explains an interesting cross section of drift over the primary country rock with leached upper soil and iron concretions between the position of the water table during the wet season and its lower position during the dry season. He says that iron concretions become solidified by silica leached from above to form "iron stone." As the landscape ages, the water table deepens and the intensity of the iron stone increases with depth. He says that stone-lines may not be found in such situations. Both Charter and I suggest that the water table Spurr is talking about is probably perched.

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M. Vanwambeke discusses the Black Clays with gilgai in the Lufira Valley (which I am to see later).

After lunch Mr. van der Merwe introduces his paper on arid soils in South Africa and we have a general discussion of the Tropical Black Clays. Some suggest that the conference pass a resoultion asking governments to give a high priority to the study of these soils. (The reason for the great interest is that many of these soils were too hard to cultivate with simple native tools and are now more or less empty and thus available for new settlement). But the Portuguese delegates insist that these soils in Angola have been used for a long time and that there is no use in giving them a special priority. In the midst of this discussion M. Leneuf introduces his paper on the "cotton soils" of the Upper Volta. It seems obvious to me that members of the conference are talking about quite different kinds of soil - certainly different soil series and perhaps different great soil groups. Some crack much more than others. The amount of gilgai varies widely. They vary widely in total clay, in kind of clay, in exchangeable sodium, and in parent material.

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I return to the hotel for a quick change and go to the home of the South African Consul-General for cocktails.

Later I have dinner with Edelman and some of his associates who have just arrived. In my view Edelman has gone overboard in promoting very rapid "soil" mapping with aerial photographs. We have a very earnest discussion - even a few sharp words about it. I do not object to general reconnaissance mapping from aerial photographs but I seriously object to calling such maps soil maps.

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August 14

Since I am an observer and not an official delegate to the Inter-African Soil Conference, I do not think it appropriate for me to attend the final session, which deals with resolutions to member governments. After some long talks with Tavernier I go out to the meetings for a lunch given by the Governor-General of the Belgian Congo. This luncheon turns out to be heavy and dull. It lasts altogether too long.

I work on my notes and have dinner with Ignatieff, Green, Muir, and Hockensmith, who has just arrived.

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August 15

In the morning I work on my Gold Coast notes and the pictures that have just been developed here in Leopoldville.

Several of us go out to a most interesting exhibition of all manner of native products. Normally this exhibition comes at a different time but it was rescheduled so that we could go. The products exhibited include vegetables, fruits, flowers, clothing, hats, pottery, paintings, ivory carving, and the like. The exhibition is very colorful and well done and supported by a fine native orchestra. I buy a little wooden elephant with ivory tusks and a native spear, something I have long wanted. I'm told that the wood for the elephant is Milletia vesicolor.

At 11:30 a.m. Jurion takes me to a reception for the Congress in the town hall of Leopoldville. Most of the Americans have now arrived.

After a late lunch I go out to the headquarters for the first meeting of the Council of the International Society of Soil Science. This lasts for a rather long time partly because of my insistence that the Society entertain no resolutions intended for governments, either individually or collectively. I agree to serve as chairman of a committee on nominations. The Council supports a motion of mine recommending Prof. E. Truog for honorary membership in the Society.

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Lelopoldville, August 15. At native exhibits. Kellogg has just bought a spear. To his right is Dr. Ignatieff; just back of him and a bit right is Dr. E. Walter Russell; to his left are M. Jurion, -----, Dr. H. Green, and Prof. S. Henin.

XVIII a

AU CONGO BELGE

Le groupe des participants à la 2ème Conférence Interafricaine des Sols qui s'est tenue à Léopoldville, visitent l'exposition artisanale et horticole organisée le 15 août 1954.

Photo C. Lemote.

Congopresse.

August 15

Native exhibits at Leopoldville. Kellogg has just bought a spear. To his right is Ignatieff; just back of him and a bit right is Dr. Walter Russell; to his left are M. Jurion, ——, Dr. H. Greene, and Prof. S. Henin.

Leopoldville, August 15. Reception in the City Hall of Leopoldville. Right to left: Governor-General, Jurion, Kellogg, Focan, Bradfield.

AU CONGO BELGE

Le 5ème Congrès International de la Science des Sols s'est ouvert le 26 août 1954. Les participants ont été reçus par le Comité Urbain de Léopoldville.

Monsieur Tellet, Commissaire de District du Moyen-Congo prononce une allocution. A sa droite, Monsieur Jurion, Président du Comité Organisateur du Congrès.

Photo C. Lambte.

Congoprcasse.

N°91.3/1954/184.

Sept 15

Reception in the City Hall at Leopoldville
Right to left Governor-General, Jurion, Kellogg,
Focan, Bradfield.

Leopoldville, August 15. Reception in the City Hall of Leopoldville. Right to left: Governor-General, Jurion, Kellogg, Focan, Bradfield.

Leopoldville, August 18. Members of the Fifth International Congress of Soil Science

XVIII c

Members of the 5th International Congress of Soil Science.

Leopoldville, August 18. Members of the Fifth International Congress of Soil Science

XVIII c

August 16

Early in the morning I have conferences at the headquarters about Society affairs. At 10:00 a.m. we all go to Albert Hall for the opening of the Congress by the Governor-General of the Congo, M. Petillon. M. Jurion gives an excellent address as president of the congress and we have a short business session.

After lunch I go to the first meeting of Commission V and hear a paper by M. D'Hoore on the accumulation of free iron oxide. Charter raises the question of laterite in sedentary material with no transported material above it. But I should say that D'Hoore recognizes what he calls absolute accumulations and the relative accumulations to take care of the situations Charter raises.

We have a discussion of catenas in East Africa followed by a very long statement by Prof. Kubiena. What he says conveys absolutely no thought to my mind whatever. Dr. Buringh of the Netherlands introduces a paper on soil and land classification in Dutch New Guinea. He undertakes to explain how to make a "soil" association map from aerial photographs very rapidly with scarcely any field work. He claims that a so-called "soil" map was done for several thousand square kilometers in two months. To me this is ridiculous.

Charter claims that in his experience aerial photographs are not significantly helpful under the following conditions: (1) closed rain forest, (2) burned savanna, and (3) shifting cultivation.

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Sous le Patronage de S.M. le Roi

M. Petillon, Gouverneur Général ouvre à Léopoldville le Vème Congrès International de la Science du Sol

Le Vme Congrès international de la Science du Sol a été ouvert ce matin à Léopoldville, par M. Petillon, gouverneur général.

Les 200 congressistes étaient arrivés dans la journée d'hier. Ils furent reçus à 11 h. au District par M. Tollet et Mme, entourés des membres du Comité Urbain.

La séance d'ouverture eut lieu ce matin à 10 heures, en présence des plus hautes autorités administratives, religieuses et académiques, et du corps diplomatique, conduit par Mgr Sigismondi, délégué apostolique.

Une foule nombreuse suivit cette séance.

Au bureau, décoré des fanions des diverses nationalités participantes, MM. Jurion, président du Congrès, et Tavernier, président de la Société Internationale de la Science du Sol, entouraient M. Petillon, gouverneur général.

M. Tavernier rappela tout d'abord que ce Congrès était le premier à être organisé dans un pays tropical. Il exprime la reconnaissance de la Société au Ministère des Colonies Belge et à l'Inéac qui ont rendu possible l'organisation de cette manifestation au Congo.

M. Jurion, de son côté, rappelle en tant que président du Congrès que le Roi a bien voulu accepter d'accorder son haut patronage à ce Congrès, ce dont il le remercie bien respectueusement. Le Roi, en accordant son patronage, a montré, déclare M. Jurion, que l'intérêt que la Dynastie belge porte aux sciences continue avec sa personne et avec celle de son frère, Son Altesse Royale le Prince Albert, récemment nommé à la présidence d'une importante institution scientifique. M. Jurion propose ensuite l'envoi du télégramme suivant à Sa Majesté :

« Deux cents spécialistes du sol représentant 21 nations réunis au 5me Congrès International de la Science du Sol expriment leur respectueuse gratitude et leur reconnaissance à Votre Majesté qui

Le Gouverneur Général prit ensuite la parole ouvrant ainsi officiellement le 5me Congrès.

Après avoir salué le Gouverneur Général qui, par sa présence, témoigne du haut intérêt des autorités congolaises pour le Congrès qui débute aujourd'hui, le président a remercié les entreprises de transports : Sabena, C.M.B., Otraco, B.C.K. qui ont rendu possibles les déplacements passés et à venir des congressistes. Il remercie enfin les autorités françaises qui ont organisé une excursion du Congrès à Brazzaville dimanche prochain.

(Suite en page 6.)

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LUNDI 16 AOUT 1954

A LÉOPOLDVILLE

Le Congrès des Sols reçu par la ville

Hier matin, dans la grande salle de mariages du District, M. Tollet, commissaire de District, et les membres du Comité Urbain avaient organisé une réception officielle en l'honneur des membres participant au Congrès des Sols qui sont actuellement à Léopoldville.

En quelques mots très brefs, M. Tollet marqua la joie et l'honneur que ressent la ville, a avoir reçu dans ses murs les éminentes personnalités de tant de pays qui participent au Congrès.

De son côté et en tant que président du Comité d'organisation du Congrès, M. Jurion répondit en disant combien le concours de la ville avait été précieux aux organisateurs, et combien chacun des membres du Congrès avait été touché de l'accueil enthousiaste leur réservé à Léopoldville. Une coupe de champagne fut ensuite servie pendant que les membres du Comité Urbain et du Congrès avaient ainsi l'occasion de prendre contact.

R. L.

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Ouverture du Ve Congrès des Sols

(Suite de la page 4.)

DISCOURS DE M. PETILLON

Messieurs,

C'est, pour ce pays encore tout neuf, un privilège qu'il apprécie grandement, de pouvoir dispenser son hospitalité — matériellement limitée mais cordialement offerte à une réunion de savants aussi éminents, venus de toutes les parties du monde pour mettre en commun les résultats de leurs travaux scientifiques.

La Belgique, que je représente ici, est extrêmement sensible à l'honneur que vous lui faites de vous réunir sur sa terre d'Afrique.

Qui eût osé imaginer, il y a trois quarts de siècle, au moment où d'illustres géographes, réunis à Bruxelles sous la présidence du Roi Léopold II, envoyaient Henri Morton Stanley dresser une première carte du continent inconnu, que — si peu de temps après — dans cet endroit où il planta sa tente le 3 décembre 1881, vous viendriez vous pencher sur les problèmes qui intéressent la vie et le bien-être de toutes les populations du globe ?

Dans tous les domaines de l'activité humaine, c'est la recherche scientifique pure qui permet et provoque le progrès matériel. Quel meilleur exemple pour illustrer cette vérité que le vôtre, Messieurs, qui vous baissez vers la terre pour l'étudier, la mieux connaître et la préserver, l'enrichir et l'exploiter au profit de ceux dont le sort essentiel dépend d'elle ? C'est au patrimoine fondamental de notre humanité que sont — dans le but toujours présent à vos esprits d'aboutir à des résultats concrets — voués vos soucis de tous les jours, dédiés vos efforts conjugués ; c'est à lui que vous consacrerez vos prochains débats, inspirés de vos plus récentes expériences.

L'Afrique est, sans doute, l'une des parties du monde où se posent avec le plus d'acuité les problèmes du vieillissement des sols, de leur usure, de leur destruction qui font votre tourment.

Conscients de cette situation, les Gouvernements responsables des Territoires au Sud du Sahara leur ont réservé une place importante dans le système de coopération technique qu'ils ont institué : Bureau interafricain des sols, centralisant et diffusant de Paris une somme considérable de renseignements et d'informations ; Service pédologique africain installé au centre de recherches agronomiques de Yangambi, dans la Province Orientale de ce pays; comités régionaux se consacrant à l'examen des problèmes du sol tels qu'ils se présentent dans les différentes zones de l'immense continent; enfin, de temps à autre, une conférence interafricaine des sols dont la deuxième s'achève dans ces lieux mêmes où vous allez tenir vos fécondes assises.

Cette préoccupation majeure de nos gouvernements nous serait un motif suffisant d'intérêt pour vos travaux, si leur excellence ne justifiait par elle-même l'assistance qu'il faut leur accorder, le prix qu'il convient d'y attacher, le bien qu'il s'impose à tous d'en retirer.

A cela s'ajoutent le réconfort et l'espoir que doit faire naître, dans le cœur de ceux qui y sont attentifs, le spectacle de tant d'hommes de bonne volonté qui, sous le signe du rapprochement des peuples et de la concorde internationale, s'assemblent pour étudier une matière, le sol, qui, par son universalité débordant largement les techniques qui leur sont familières, intéresse les juristes, les économistes, les sociologues et, pour tout dire, les hommes depuis les chefs d'état et les gouvernants jusqu'aux plus humbles de ses occupants.

Dans le cadre qui s'étend ainsi aux limites mêmes du monde et embrasse tant de domaines de l'intelligence et de l'activité humaines, les études que vous allez poursuivre au cours de votre séjour parmi nous, seront d'une importance essentielle.

Je formule, Messieurs, des vœux sincères, pour le plein succès du Cinquième Congrès International de la Science du Sol auquel Sa Majesté le Roi des Belges a daigné accorder son Haut Patronage.

Ce fut alors M. Jurion qui ouvrit les travaux en traçant une synthèse des réalisations obtenues, ainsi que des errements, dans l'agriculture tropicale au Congo Belge.

Il parla du maintien de la fertilité du sol et des moyens adéquats pour empêcher l'érosion. Il plaça enfin les travaux du 5me Congrès dans leur perspective qui est d'étudier les sols, afin d'améliorer les méthodes agricoles et de contribuer au mieux-être des populations rurales.

Il faut saluer comme il convient cette première et importante manifestation scientifique dans la capitale du Congo Belge et formuler le souhait que des congrès de ce genre se multiplieront et que Léopoldville, afin de les recevoir, puisse être équipée convenablement.

Mr. Thomas presents a paper by B. S. Ellis in which he says that soil classification should be based upon rocks. This might have been a good paper if presented during the founding of the Rothamsted Experimental Station! He has confused local soil differences with continental soil differences.

After this we go to a very pleasant garden party given by the Governor-General at which I believe I arranged for Professor Tavernier to visit us another year.

Dinner with Dr. Bradfield and late to bed.

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August 17

I'm up early and prepare for my general lecture on Soil conservation this morning. (I am pleased to see that a full translation into French is available. See Appendix). This I give at the first plenary session at 8:00 a.m. It seems to be well received.

At 10:40 a.m. we have a special session for the discussion of my paper some of which is quite lively. Since I am unable both to answer questions and to take notes, Mr. Hockensmith has agreed to take the notes.

We break up for lunch and then return for more discussion of my paper. This lasts until 4:00 p.m. ! I'm just about worn out and go back to the hotel for a little rest.

I have an early dinner with Ignatieff and review for him the agricultural problems of the Gold Coast. Early to bed.

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C. G. 2. — Soil conservation

BY

Charles E. Kellogg
(U. S. Department of Agriculture, Washington, U. S. A.)

Throughout the history of civilization there have been times that demanded a reevaluation of basic goals and opportunities. We are living in such a period now. No civilization has been challenged more sternly than ours. Millions of people are newly aware of the possibilities for them to have more food, more opportunity, and more share in shaping their own destiny.

What happens to world civilization in the years ahead depends a great deal on how we can manage our soils. Obviously, if the world is to have abundance, we shall either increase the harvest, and the efficiency of producing it, from the soils now being used, or bring pressently unused soils inton efficient use, or do much of both.

Is the abundance in our soils ? And if so, how can it be realized ? Elsewhere I have answered the first question in the affirmative (4, 6). On this occasion I should like to discuss with you the second question : How can we reach a high level of sustained production ?

It is very easy to be pessimistic about this problem. Many have been. While I realize fully the enormous complexities involved, and even admit that we do need to keep reminding ourselves of the difficulties, our present need is to think and to act aggressively on the constructive side if we really want to save what is good in our civilization.

Without proper soil use and management we shall not have abundance nor even hold our own. Yet a great deal besides soil science is involved — almost the whole of our social structure. Still we must start with our soils, not only as isolated natural phenomena, but also in relation to the whole natural and cultural

environment within which they produce. We must work for abundance. Also, we must work for a balance between resource use and population. Especially must we work for the freedom and security of the individual cultivator.

Soil conservation defined.

So far I have not used the term « soil conservation », but that is what I have been talking about. Originally this term was used by many in the narrow sense of soil saving, especially against erosion. The control of erosion and of the many other soil-depleting processes is a part of soil conservation. But the soil characteristics that we need to preserve are also the ones we need to develop or improve in many soils. The practices that build up and maintain soils are also the ones that give us production. We cannot separate them; and certainly the cultivator cannot seperate them. The most important principle of soil conservation learned from recent research and experience throughout the world is the one that success depends upon combined practices fitted to the individual kinds of soil and not upon a single practice approach.

As we use « soil conservation » now, it is a *positive* term. Soil conservation includes the whole system of soil use and management practices that gives efficient and abundant production on a sustained basis, according to the specific patterns of soil and water resources of the individual farms, ranches, plantations, rural villages, forests, and other land management units. It means continual efficient use and stability of each soil that is needed for use at its optimum level of developed productivity.

Within a favorable economic and social environment, the adoption of an efficient system of soil conservation by a farm family depends upon three firm principles : 1° Responsibility for decision by the farm family, strengthened by technical assistance and specific information given through; 2° the use of a soil map and explanations of the alternative uses, management practices, and estimated yields of the significant kinds of soil for; 3° the development of the unique combination of practices that makes the best use of all the skills and ressources available to the farm family.

Many essential conditions and services contribute to an environment within which this procedure, outlined so simply, can lead to beneficial results. Besides a firm scientific basis for the technical practices, there must be motivating incentives for the cultivator to adopt a superior soil conservation system and opportunities for him to do so.

We have heard much about a « natural balance » between people and their resources. In the sense of a return to some primitive way of life, no hope for appealing to people lies along that way. What we seek is a « cultural balance », wherein men may realize their hopes and opportunities through full use of the tools of science and technology.

Such a cultural balance involves not only and water but also the command of energy and industrial products that makes the thought and effort of the cultivator effective. On many soils electric power and chemical fertilizers, to mention two examples among many, are as important to high level production with soil conservation as the very soil itself.

« Soil » and « land ».

This thought leads me to mention the contrast between « soil » and « land » (7).

As soil scientists we deal with « soils », which are natural phenomena that occur as areas on the face of the earth as a result of unique combinations of parent rock, relief, climate, living matter, and age. Areas of the same kind of soil may exist within two or more contrasting economic and social environments, with the consequence that they have different uses and productivity.

« Land » is primarily a social, or socio-geographic, concept. It is the area within which production takes place. « Land » is real estate, property. The individual units of agricultural land — in farms, ranches, plantations, and the like — are defined by property lines, which are not necessarily coincident with natural boundaries. Location is an essential feature of land. Tracts of land with similar soil may be either nearly worthless or highly valuable because of differences in the size, location, or management of the tracts. Some of our best farm land, most productive in an economic sense, had naturally infertile soils to begin with. Many millions of acres of poor land in the world are poor not because the soils are unresponsive but because of location in relation to transport, industry, markets, and other facilities; because of inadequate size of tracts — too small or too large; or because of the low state of the agricultural arts in the region.

In suggesting improved practices for increasing production, we must continually recall that improving the soil may not help if some other characteristic of the land unit is limiting. Nor will changing the other land characteristic help if te soils are unresponsive.

These distinctions, already very important, will become more so. The percentage contribution that the soil makes to agricultural production is diminishing in relation to that of such industrial products as chemicals, machinery, and power. We must expect even greater contrasts among tracts of land having similar soils.

Production opportunities.

An appraisal of the opportunities of soil use involves both the soils and their management. How often have people underrated the potential of an area simply because primitive indigenous people received poor harvests from their skill and methods ! This is especialy true in the tropics. Yet on other areas of similar soils, potentially like those farmed by the poor natives, world production records have been set. In primitive societies, only those soils that have within themselves the dynamic to remain productive can be used continually with good crop yields. Few such soils exist in the world — in the tropics or elsewhere.

The cultivators in advanced societies are not limited by the productivity of soils when simply plowed and seeded. The important quality of a soil is its response to management — the extent to which it may be made economically productive. The larger part of the soils in western Europe and in the eastern part of the United States were not naturally fertile. They have been made so.

Generalizing very broadly, soil management systems may be placed in three broad categories :

(1) Traditional, more or less primitive, systems developed without the benefit of modern science and with few or none of the facilities of modern industry. Such « native » systems may or may not lead to soil depletion; but they are usually far less efficient than they could be. Continuous use with reasonably good labor incomes is confined to a small part of the world's soils. On many soils short periods of such use are interrupted with long rest periods under native plant cover or even terminated by serious soil depletion.

(2) Systems using techniques developed through the application of modern science but with only the very minimum of such industrial products as machinery and chemicals. In a newly developing region still deficient in transport, industry, and operating capital such a stage often precedes systems of the next category. That is, by applying the principles of modern science, even without many industrial products, the skilled agriculturist can make big improvements over the yields of the indigenous native and can use soils effectively that the native soon « wears out ».

(3) Efficient management systems that involve the wide application of modern technology including full use of the products of modern industry.

Within each of these broader categories there are further variations in soil management depending upon the local environment and the skills and resources of the individual cultivators.

Crop yields and the ratios of outputs and inputs vary widely on similar soils under contrasting systems of management. Any appraisal of potentialities involves an appraisal of the management systems as well as of the soils. Since management systems are primitive in many parts of the world, many have been led into serious under-evaluation of soil productivity.

Elsewhere estimates are discussed which suggest that we could increase the soil used economically by some 50 percent and the yields from presently cultivated acres by some 20 to 50 per cent on the basis of what successful farmers are now doing (4,13). More recent evidence, familiar to you, leads me to regard these estimates of potentialities as conservative. Yet still we have food shortages in places and low labor incomes among a majority of cultivators throughout the world.

The problem.

This low level of efficient production in the world generally, and the conflicts over recommendations for action, both testify abundantly to the great complexity and difficulty of the soil conservation problem. Certainly, I should not need to remind my colleagues here of the enormous contrasts among kinds of soil. When we are talking about soil conservation here at this International Congress, we are talking about many thousands, many hundreds of thousands, on kinds of soil. Since all of the characteristics that affect their potential use and behavior vary from one another over wide ranges, so do such qualities as native fertility, response to the thousands of combinations of management practices, and susceptibility to various deteriorating processes.

Although we have learned a lot about soils and about the nature of our basic soil conservation problem in the past 50 years, we all know that we have scarcely more than begun the highly specialized research required for understanding our soils and for developing efficient technology. These deficiencies have led to failures of

important soil conservation and development schemes [1] and they handicap effective transfer of experience from one area to another.

As I read the history of soil science, the greatest single source of error has been the attempt to relate experiences and predictions to single soil characteristics. During the past 20 years I feel we have made real progress to eliminate this fallacy. It is increasingly appreciated that the influence of any one soil characteristic depends upon the other characteristics. We know that we can usefully conceive of a soil only as an integrated body with many characteristics. We have learned that the same principle applies to the dynamics of soil development and soil degradation. Rarely are we dealing with a single dominant process. Take soil erosion, for example : As we have studied the process over the years we have found it intimately related to changes in the nutrient supply, to alterations of soil structure, indeed to all those processes that significantly modify either the characteristics of the soil or the growth and density of its cover.

We have learned the narrow limitations of single management practices. To be sure examples may be cited where the introduction of a single practice has been exceedingly beneficial. These are with the relatively few soils where all of the other conditions are favorable for the final good result. But such soils are not common. As we continue to advance in fertilizer technology, for example, we are increasingly concerned with combinations of nutrients, and with the influence of each one on the others (3). We are increasingly concerned with proper combinations of crops in both mixed cultures and rotations. In summary, recent evidence shows clearly that our greatest achievements in soil conservation have come about through the interactions of many practices, not from the dramatic influences of a few special single practices.

An analysis of our current concept of soil productivity leads us to expect this result. The soil must have an adequate air supply, an adequate moisture supply, and an adequate supply of plant nutrients in balance. A productive soil for most crops drains readily; it admits water easily; and it holds the water from one wetting to another. Thus we might go on with a long list of closely interrelated factors and processes responsible for the harvest we get in relationship to the trouble of getting it.

Some of us have also tried to divide our soil conservation problem in another way, say by raising this kind of question : Can

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[1] Contrast, for example, the outcome of the Groundnut Scheme (19) with the successful Gezira Scheme (2).

we not divide our soil depleting processes into two kinds, those with permanent effects and those with only transitory effects ? In the first category we should include devastating erosion that removes the very body of the soil itself down to underlying hard rock. An example in the second category would be the simple exhaustion through cropping of available nitrogen that could be readily overcome by a standard nitrogen fertilizer. Although such extremes exist, very few of our actual soil conservation problems can be so neatly classified. Commonly several processes of soil depletion go on together. Erosion, for example, does not often go to the point of uncovering hard rock; but is may uncover lower soil horizons in which productivity is maintained with difficulty. The new surface soil is commonly harder to work. Through fertilization and other techniques we may be able to restore productivity to the former level or even increase it greatly, but at a higher cost for labor and materials than for the uneroded soil. If an arable soil is allowed to become depleted in nitrogen, or in any other plant nutrient, commonly the loss of other nutrients and a deterioration of soil structure are initiated.

Since we cannot so neatly classify the problem, how do we assess the soil conservation needs of any soil or area ? Theoretically, we might divide the problem, stated in this way, into two aspects : 1° What do we need to do to keep the soil in its present state, or to prevent deterioration ? 2° What do we need to do beyond this for increased production and increased efficiency in order to meet the requirements for agricultural production ? At first glance this division appears reasonable. Certainly we do not want further soil depletion and we do want to use as efficiently as possible the soils that are cropped.

But here again, the problem cannot be so neatly divided. Rarely can the cultivator take some sort of half-way combination of measures that simply prevents depletion. If he is going to succeed as a cultivator he must have a soil conservation system that pays. This means a system that includes a level of investments in labor and materials high enough to permit him to produce efficiently for the market as well as for his family. If he does not reach this level of efficiency his system will not pay at all, and he will scarcely hold his own. Even his simple measures will break down. Thus for most situations our first goal should be to get a rational decision as to whether or not to use the soil for intensive agriculture under cropping. If the soil is suitable, and if the decision is to use it intensively, then we should encourage the development of systems at a high level of efficiency in the use that has been determi-

ned. If the soil is not suitable, or at least if we are unable to suggest an efficient system, then we should encourage some system of extensive management that the soil can support.

Assuming for the moment that we can develop adequate procedures for identifying the best soils to use for various purposes, and for determining suitable combinations of practices to go with them, we are still dealing with the relatively simple part of the problem of getting soil conservation adopted. We must continually remind ourselves that in a democratic society, the decisions are made within the boundaries of operating units by the farmers, the ranchers, the plantation managers, the foresters, the village council, and the like. They are not made by the soil scientist. The job of the soil scientist is to furnish those who matke the decisions (or those who provide technical assistance to those who make the decisions) the best predictions he can, on the basis of his surveys and the research and analyses of experience with the various alternative systems that the cultivator can employ. The manager of any operating unit, be it tiny or be it great, is subject to a great many influences that bear on his decisions.

The small cultivator trying to go from an unproductive or wasteful system of management to an efficient system may find himself confronted with economic handicaps that he is unable to overcome by himself. Unless these handicaps are resolved, our soil technology, however superior, has no chance to become effective. Difficult as are the technical problems themselves, it is my view often that these economic and institutional problems are more difficult. Since their solutions are essential to carrying on our work and are so intimately associated with it, as operating soil scientists we must take a large part of the responsibility for them.

The basic problem is one of helping the cultivator to make the best possible decisions. Most of the superior systems of soil conservation require rather long-term planning. We must help the cultivator think in terms of 5 years, 10 years, or even 15 years, not just the year ahead. First of all, of course, we must have the facts. The cultivator must realize that he can better his situation and he must want to do so. Then the facts must be presented in ways that he can understand them and can use them. His terms are not necessarily ours. Then too, he must have the skill, security of tenure, credit, and all the other facilities that make a good system possible. Not the least important is a healthy national economy within which agriculture as a whole and the individual cultivator in particular may flourish.

This may seem to make of soil conservation an enormous undertaking. It is. And all the parts must fit together. But the alternatives to soil conservation as I have tried to define it, are continued famines and gluts, continued soil depletion and wastes of human labor for millions of cultivators, and the inevitable political and social consequences of mass frustration. As soil scientists we know that these conditions are not necessary. The abundance is in the soil and man can change his economic and institutional arrangements if he sets his mind to it.

Now, I should like to explore in broad outline some of the main parts of the problems as I see them.

Research.

Despite its amazing record of accomplishment, agricultural research in general and soil research in particular, have received only token support in most countries of the world. This situation seems to have resulted from 5 principal factors :

(1) Agriculture is still regarded by many as an occupation of low social status. This is a common view even among cultivators themselves. In some countries this attitude extends into the very ministries of agriculture and to the groups of men who devote their lives to professional agriculture.

(2) In contrast to his colleagues in other fields of science, the professional agriculturist is so continually pressed for immediate « practical » results that basic scientific research has lagged behind the immediate technical research with consequent long-run loss of efficiency.

(3) Much of the interest in agriculture is focused upon specific products to the neglect of the more basic principles of soil behavior and soil-plant relationships. Among evidences of this tendency are the large numbers of small, often halfstarved, special institutes or testing stations for individual crops.

(4) Travel costs along with the occasional inconveniences and arduous work required for the study of real soils out-of-doors have combined to localize unduly and to unbalance much of our soil research. Although full use needs to be made of the laboratory, effective results depend upon close coordination with adequate field work.

(5) Soil research has been regarded as almost exclusively the function of publicly supported institutions. Consequently, few soil scientists have the opportunities for concentrated basic research characteristic of the privately endowed universities, or the opportu-

nities for the large salary advantages of their scientific colleagues who work in industrial research laboratories.

None of this is said with any feeling of pique or jealousy. Yet these are hard facts that do result in serious problems of recruitment to soil research and wide gaps in the essential scientific knowlegde needed for reaching reasonable goals in soil conservation.

They are handicaps that must first be recognized to be overcome. Certainly first of all as soil scientists we should try to do the best with what we have. And we do have many opportunities. I should like to outline briefly the five lines of research that I regard as most pressing.

First, I would emphasize the need for a firm body of scientific principles, which can only come from basic research applied to the real soils that we have. In no part of the world is this need more urgent than in the tropics. The invention of techniques here as elsewhere can never get ahead of the basic research. We must know the soils, in detail, and how they function.

Second, we must develop accurate soil surveys of all potentially useful areas. The requirements and methods have recently been explained in some detail (9, 14, 15). I should like here to stress only three points : 1° Short-cut surveys, and expecially those which avoid careful study of the soils themselves, are bound to be untrustworthy and ephemeral. I grant readily that it is much easier to study aerial photographs and the above-ground parts of plants than it is to study soils. But dig we must. 2° The Soil Survey, as an institution devoted, to soil study, must be broad enough in scope to include the basic research in soil genesis and morphology, on the one hand, and to develop a synthesis of the results of research and experience into definite predictions for the use and management of the individual kinds of soil, on the other. 3° The maps and explanatory texts of such a Soil Survey, firmly based on scentific principles, furnish the factual basis for many purposes and especially for a soil conservation program. Or to put the principle the other way around, a soil conservation program is a program for putting the results of the Soil Survey into action.

Third, we need a research program in soil management that can develop new and more efficient combinations of soil-management practices to insure soil improvement and stability at a high level of efficient production. Much of our present effort could be made far more effective by closer coordination with both basic research and the Soil Survey. Although the mere testing and comparison of more or less standard system is helpful, especially as an

exploratory first step in new areas, I am persuaded that more boldness of imagination can lead to some entirely new and better methods that take into account the emerging principles not only of soil science but also of engineering and the other sciences.

Fourth, I should like to emphasize the urgent need for more pilot-research farms (4, 5, 11). By a pilot-research farm I refer to a farm under experimental study on which the aim is to find the optimum *combination* (or combinations) of practices suited to the farm as an operating unit. Often the cultivator, or even the farm advisor, is presented by the scientists with an uncoordinated bundle of recommendations about single practices. The final research necessary to fit these together is left to the operating cultivator. More often than not he is unable to do this research, partly because of the great financial risks involved.

Fifth and lastly, I suggest the need for greatly increased attention to the economics of soil conservation. The basic data come from all the preceding lines of research and from the analysis of operating farms. By taking the results of measured harvests under physically defined systems of management, by individual kinds of soil, production functions can be established that give faire guides to the economic results under different sets of cost-price conditions. The cultivator wants to use the combination of practices that maximizes his returns. As I have already pointed out, most of the best systems of soil conservation can be evaluated only over a period of years. In going from a poor system to a good system, costs often exceed the returns for the first year or so. Then as time goes on and the system becomes effective, income rises and exceeds the costs.

We need to know the characteristics of the cost curve and of the income curve and where they cross for different combinations of practices on different kinds of soil. Only by some estimate of these curves can the cultivator make a wise decision. And usually he is not the only one involved. Frequently he has need for credit. Some one needs to appraise, for both the cultivator and the creditor, the real economic possibilities. I am completely persuaded that the best soil conservation systems which we now have would be more generally adopted if their economic characteristics under the relevant local situations were precisely analyzed and the results presented to both advisors and cultivators.

Education and technical assistance.

Obvioulsy, the effective use of technology for soil conservation requires that cultivators learn new principles and new skills, especially those who make management decisions. Two quite different approaches are useful and necessary to help meet this problem. One we may call « education », and the other « technical assistance ».

Certainly the first step is to help cultivators to realize that they can improve their own situations. My own view is that many of our attempts at vocational agricultural education would be more effective with more emphasis on general education, on the basic skills of learning. In any area, of course, we must start where the people are now, and begin by emphasizing the existing cultural values that are consistent with scientific soil management rather than by direct negation of those that are not, even though these must be modified ultimately for success.

In our soil conservation advisory work with cultivators we can clearly recognize some principles and techniques that can be generalized while others need to be worked out specifically in relation to each individual farm unit. In my own country, for example, we have called the generalized agricultural education « extension ». This phase of the work is carried on by our cooperative Federal and State Extention Service. Technical assistance is carried on by the Soil Conservation Service. Both agencies of course, work together and with other agencies dealing with other phases of the soil conservation problem.

Cultivators can be assisted in solving many of their problems through the general educational process appropriately supplemented with community demonstrations. But the unique problems of fitting specific soil conservation farming systems to the specific patterns of soil and water resources on individual holdings *cannot be generalized.* With the way prepared by education, and with local community understanding, these individual farm problems can be dealt with only one by one — holding by holding — if anything like full use is to be made of both our soils and our technology.

For effective results, this individual guidance begins with a soil survey of the holding that shows the individual kinds of soil and gives explanations of both their capabilities for various crops and other uses and their management requirements for sustained production. For most kinds of soil the cultivator has several alternatives. The one adopted depends on the size of the holding, labor

supply, skill of the operator, and the other characteristics of the management unit.

Beginning with a basic soil map, and considering the other factors influencing the management system, the operator can be helped to develop a sound conservation and production plan that fits his unique situation. Such plans needs to be flexible. They should change as his skill and experience grow and as economic conditions change. Above all, this planning process should help him learn to use scientific principles and technology in arriving at his decisions and in carrying them out. Our aim should be to increase his confidence in making decisions for himself (10).

Besides assistance for his decision making, the cultivator commonly needs some direct assistance on practices requiring special skills that few if any cultivators can be expected to have. Examples include the testing of soils for plant nutrients and the engineering layouts for drainage, terraces, torrent control dams, and irrigation.

Tenure.

In many countries landlords must take greater responsibility for the welfare of the cultivator who does not own the land he farms. Security of tenure and a fair share of the harvest are among the first essentials for a soil conservation program. The change from a poor to a good system of farming almost universally involves long-term planning. The cultivator cannot be expected to apply lime and fertilizer, build terraces and other water-control structures, establish improved pastures, or carry out similar practices that can repay his labor and materials only over a period of years, unless he is reasonably certain that he will be on the holding to receive a fair share of the improved harvest or at least that he will be fully compensated for the improvements he has made.

Tenancy itself is not necessarily bad, but the system may be good or bad. A system that insures a fair return to the tenant-cultivator also gives more to the landlord because a modest percentage of the harvest from a good system of soil conservation farming usually amounts to far more than a very large percentage of the harvest from a bad system carried out by a poor cultivator uncertain of his future.

Consolidation of scattered holdings.

In many countries the problems of tenancy and small total size of holding are sometimes complicated by the fragmentation of the holdings into tiny scattered tracts. During recent years several

countries, especially in western Europe, have carried through, or at least initiated, programs for consolidating the scattered tracts into single holdings under special laws (1). Further progress is urgently needed since the efficient use of machinery and the proper development of mixed farming with either long leys or crop rotations with short leys are generally essential parts of a soil conservation system. With these tiny scattered tracts, road systems are unduly complicated, controlled grazing is impractical, and it is exceedingly difficult to develop proper systems for irrigation and water disposal.

Soil scientists have two special responsibilities in this problem : 1° They should give emphasis to the great handicaps of fragmented holdings for productive conservation systems of management. 2° Through the use of an accurately made and interpreted soil survey, a plan can be made for consolidation that will be fair and convincing to the cultivators and land owners.

Credit and cost-sharing.

Either the development of new land or the change from exploitive, low-yielding systems of farming to high-yielding soil-conserving systems, often require labor and materials in advance of the returns.

Full rewards may be delayed for 5, 10, or even 15 years. During such a period most cultivators need direct financial assistance. Those already having demonstrated skill and considerable assets can usually get credit, and on reasonable terms, in many countries at least. But with the poor cultivator who needs to develop his skill during the period of change-over to the improved system, the credit problem is far more difficult. Usually some governmental credit agency is required along with schemes for close integration of the credit program with the on-side technical assistance. Neither the credit nor technical assistance can succeed without the other.

As the productivity of the agricultural community rises, all society benefits. All sources of revenue rise. Then too, the public as a whole must take much of the responsibility for the long time development or degradation of soil resources. In many situations substantial cost-sharing by the society as a whole is fully justified (8). Besides making credit available, governments can often appropriately make direct payments to farmers to pay part of the cost.

Here too, soil scientists have a special responsibility to learn and to explain the long time potentialities for production and in

this way give a basis for the firm guidance of practical credit and cost-sharing programs essential to realizing these potentialities for the public welfare.

Market and prices.

I want only to mention markets as an essential factor in soil conservation and to stress the growing importance of agricultural cooperatives to our goals as soil scientists.

If the ratio of farm costs to prices is high, the cultivator may find it impossible to maintain his soil-conserving system. With very low prices for their products, cultivators fail to use the fertilizers and machines that are necessary to maintain their soil. With very high prices, on the other hand, cultivators are inclined to plow and to plant too much, and on the wrong soils. In fact, few factors are as harmful to the sound progress in soil conservation as sharply fluctuating prices. I emphasize this fact because some think of soil conservation and agricultural price stabilization as different problems. In a way they are; but they are very closely inter-related.

Combined resource use.

Modern soil conservation depends increasingly on such industrial products as fertilizer, machinery, and electric power. With a proper fit between the combination of practices used by the cultivator and his soils, the proportional amounts of production due to the soil is decreasing and the amounts due to skilled labor and to capital goods are increasing. Thus success in soil use implies effective employment in both country and city and a reasonable balance between industry and agriculture.

Increasingly will progress in soil conservation depend upon parallel progress in the use and development of other resources, especially of water and energy, and of the whole group of facilities required for transport, health, and education.

We cannot discuss here the details of the many ways that combined resource use can best be assured in individual areas. The Tennessee Valley Authority in the United States is an example of a national governmental agency taking the initiative in full cooperation with local governments and private agencies. The Union Minière du Haut Katanga in the Belgian Congo is an example of a large private organization with representatives of government taking part in the decisions. The most appropriate way to organize for effective combined resource use in any area depends upon local

circumstances not the least of which is the existing cultural pattern from whence the start must be made (4,12). That is, because a particular sheme works well in one country does not necessarily mean that it is adapted to another country even though the physical resources are comparable.

In explaining the potentialities of new soil areas it is well to emphasize that few places are left in the world that are adapted to individual settlement on the pattern of the 18th and 19th centuries. In other words, there is very little soil in the world waiting only for the settler and his own simple tools. Yet we have great potentialities that may the developed through planned combined resource use — agriculture, mining, and industry together. I conceive that this area where we are — the Belgian Congo — is an excellent example of such an opportunity.

Role of government.

I think we can agree that the individual cultivator should have the primary responsibility for soil conservation. Yet an analysis of the factors involved make it abundantly clear that government must take a large responsibility in order that it may be possible for the cultivator to take a long view of his operations and apply technology effectively on his holding. And since national, regional, and local problems are importantly involved, governments at all levels must take an active part in soil conservation. At first glance, bringing in so many agencies may seem to complicate our soil conservation problem. Some might even say that it would be better to concentrate the responsibility in terms of a « strong national program », « strong provincial programs », or « strong local or village programs », and thus « eliminate duplication and overlapping responsibility ». I should like to refute such ideas. If we fail to carry out the parts of the program most appropriate to these various areas of government, we shall fail to coordinate our goals in soil conservation with the other goals that people have and fail to balance public investment in soil conservation with other public investments for health, education, transport, and similar services.

Success in soil conservation depends on very close cooperation between government and the people directly invoved. Schemes that the people have little or no part in developing and that leave few decisions to them are unlikely to be successful. Enlightened local leadership is fully as important as enlightened national leadership.

Special associations set up by law are commonly effective devices through which to provide the services needed for soil conservation.

To insure having combined resource use over a broad area, a regional agency of some sort may be needed to help develop all the resources available. Drainage, irrigation, flood control, and hydro-electric power development, for example, often require large and costly engineering structures. Commonly two or more of these objectives, or even all four, are involved together. Effective use with conservation requires careful planning in relation to the soil potentialities and to the probable requirements of the individual cultivators.

Such schemes need to be painstakingly developed for specific purposes with provision for cooperation with local governments in ways that strengthen them rather than weaken them. This point is very important. One cannot be for « centralization » or « decentralization » of government, in general. Some functions must be national or regional in scope. Yet as many decisions as possible should be left to the local units of government and to the individual cultivator. We must continually recall that the democratic health of provincial and national governments depend upon that of the local neighborhoods and communities.

In my own country, perhaps the greatest single step forward in soil conservation was the organization of soil conservation districts under state (provincial) laws. These laws vary considerably among the several states but generally provide that the local farmers decide by vote in a special election whether or not they want to have in their area a soil conservation district to give special attention to the development of soil conservation on individual farms. Following a favorable vote the district is organized and the local people select from among themselves those to serve as the governing body. In this way strong local leadership is developed and a convenient mechanism created for providing services to farmers from the national and state governmental agencies (17, 18).

Of course, somewhat similar arrangements are in effect in many countries for aiding soil conservation, or for some part of the job such as drainage, irrigation, flood control, fire protection, or controlled grazing (16).

Through governmental organizations to achieve full soil conservation, we should use the planning processes, in ways that harmonize with the other values of society and that develop opportunities and responsibility for the individual, to reach three main goals :

(1) For each country to maintain such a relationship among resource use, effective employment, and population that the rate of increase of production exceeds the rate of population growth.

(2) To bring about within each resource area or region that combination of resource uses that insures full employment of both resources and people.

(3) To develop conditions so that each cultivator may be able to plan and to carry out the combinations of practices that give him maximum return for his labor and genius on a long-time sustained basis.

Even under the best conditions the total trade in food, as a percentage of the world supply, is very small. Generally, the people in each country shall need to work out their food problems largely for themselves, or at least within a customs union. Actually, exchanges of technology, and especially of the scientific principles basic to technology, and trade in materials and machines essential to agricultural and industrial development, will be far more significant to food supply than direct trade in food itself.

The challenge to soil scientists.

The evidence from soil science leads to the belief that, given favorable social and institutional environments, the world has abundant resources for a dependable food supply under efficient soil conservation practices, based upon the soils that we have and the results being obtained by a fraction of the world's cultivators. Yet we know that many cultivators are poor and operate inefficiently, that food is short in many areas, and that soil productivity is actually going down rather than up in large parts of the world.

Soil scientists have a large responsibility to bring out the latent abundance that lies within our soils. The job ahead is difficult and complicated. It is unfinished so long as we have poor people living from the soil. Of course, the job cannot be done by soil scientists alone; but certainly it cannot be done without them.

Soil scientists have done a rather poor job of explaining the requirements for constructive efforts to the public they serve. To be sure, we have had some writing about the negative side of the problem, especially about soil deterioration. Fortunately, not much of this has been done by soil scientists. The compelling need now is for steady, competent achievement on the far harder task of constructive suggestions and improvements.

Without reducing our specialization (it must even be increased to meet the critical problems of detail) we must broaden our viewpoints to see the soil conservation problem as a whole so that our work can be truly effective. We shall have to work with the rural

people, as they are, amidst their continuing problems. Rarely do we have the chance to draw plans on a clean slate in a completely new and undeveloped area.

We have come a long way since the first of these International Congresses of Soil Science was held. We have made some good beginnings. The welfare of millions of people may depend on how well we meet the critical challenge inherent in the current struggle of men to better themselves.

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Summary. — *Starting with the assumption that great unrealized potentialities exist within the soils of the world, and a definition of « soil conservation » as a balanced system of practices for efficient sustained production, the broad problem of achieving soil conservation is described.*

The great significance of combined practices is emphasized along with the relationship to the whole problem of the services and arrangements essential to make conservation planning by the individual cultivator a real possibility. These include research, education, technical assistance, credit, cost-sharing, secure tenure, consolidated holdings, stable prices, and the parallel development of industry and facilities for education, health and transport.

August 18

In the morning I attend the general sessions with good papers by both Prof. Edelman and Dr. Bradfield. After tea I go to the sessions of Commission V during which several papers are read. I'm especially pleased with Dr. Ruhe's discussion of the geomorphology and soils of the Nioka area in the eastern part of the Congo.

There is quite a bit of discussion of the "dark horizon" but not much is added to the papers for the Proceedings. More time is taken for another one of the long lectures of Kubiena. I think Kubiena has contributed a good deal to soil science through his early researches on micro-structure. But he certainly is not helping any in the general field of soil morphology and soil genesis.

I have lunch and go with a small group to some of the stores that sell to natives where I get a chance to buy some samples of cloth used in making native gowns.

I'm back to the sessions for papers by Tavernier and others.

In the early evening a few of us go to a sort of night-club restaurant in the edge of Leopoldville for a dinner that M. Jurion gives to the officials of the Society. This is very nice except that I have to make one of the "pretty speeches." After the dinner we are taken to another night club for further refreshment and song. Jurion certainly gives us an "evening" in Leopoldville.

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LE COURRIER D'AFRIQUE

MERCREDI 18 AOUT 1954

Au Congrès des Sols à Léopoldville

Le Congrès a entendu mardi matin deux conférences.

La première a été faite par le Dr. Ch. Kellogg, administrateur du Service de la Conservation des Sols aux Etats-Unis.

Partant de l'hypothèse qu'il existe un potentiel de production non exploité dans les sols du monde, et d'une définition de la « conservation du sol » comme un système équilibré de méthodes pour assurer une production soutenue et un bon rendement, l'auteur décrit le problème général de la réalisation de la conservation du sol.

Il souligne la grande importance de la combinaison des méthodes en même temps que les rapports qui existent entre l'ensemble du problème et les services et dispositions essentielles qui permettront au cultivateur individuel d'organiser cette conservation. Ces moyens comprennent la recherche, l'éducation, l'assistance technique, le crédit, la participation aux frais d'aménagement du fonds, la sécurité du locataire, le remembrement de la propriété, la stabilité des cours, et le développement parallèle de l'industrie, une organisation rationnelle de l'enseignement rural, de l'hygiène publique et des transports.

La seconde conférence a été prononcée par le professeur Aubert, de l'Office de la Recherche Scientifique dans les Territoires d'Outre-Mer à Paris. Le thème choisi était relatif aux sols dits latéritiques très largement répandus dans les pays tropicaux. On sait que ces sols conduisent souvent à la formation de croûtes ou cuirasses improductives.

L'origine des sols de ce genre peut être lointaine et avoir pris naissance il y a des millénaires, sous des climats très différents de ce qu'il est actuellement. Leur évolution se caractérise encore par une accumulation des sels de fer.

Le démantèlement de ces cuirasses et la formation à son détriment d'un nouveau sol meuble n'est pas chose impossible.

Les sols latéritiques, souvent peu fertiles, sont utilisables dans la majorité des cas, et on doit chercher à accroître leur productivité. Ils sont très fragiles et, en quelques années, des méthodes agricoles défectueuses peuvent les rendre pratiquement stériles. Il est donc de première importance que leurs caractères, leur formation, leurs réactions soient mieux connus, sinon leur mise en valeur risque de conduire à des échecs. On n'a pas le droit de laisser inutilisées ou mal utilisées de si vastes étendues capables de fournir d'immenses quantités d'aliments et de produits de première nécessité pour l'homme.

August 19

I'm up early despite the short night, since the general sessions start at eight. Dr. Green gives an excellent paper. He is followed by Prof. da Costa.

After tea I attend a meeting of the nomenclature committee. Then we resume the sessions in Commission V for a seminar on the Tropical Black Clay. The Portuguese point out that they have typical examples from limestone and more as well as from the igneous rocks. Stephens suggests that the gilgai or micro-relief might be a criterion at the family level but not for the great soil group. Charter says that he has found these Tropical Black Clays on three quite unlike land forms. Azevedo (Angola) suggests the name "gravinigra." He stresses surface gramulation rather than deep cracking and gilgai.

After lunch I go back to the city for a much needed rest rather than on the geological tour along the Congo Bluffs.

After dinner I go back out to the meeting place for a long Council meeting and I am again late to bed.

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After lunch I go back to the city for a much needed rest rather than on the geological tour along the Congo Bluffs.

After dinner I go back out to the meeting place for a long Council meeting and I am again late to bed.

August 20

In the morning I go out to the sessions of Commission V again. During the discussion Stephens suggests that we develop some special notations in soil morphology for desert pavements.

Charter makes an interesting statement, which he may or may not believe, that the way a soil has developed is itself a soil characteristic! He says "some people cannot recognize soils for the parent materials."

Dr. Muckenhausen uses bad pictures to illustrate a confused soil classification. Obviously he has based it primarily on office-developed theory rather than actual soil morphology.

Kubiena speaks again. He does make one point that I can understand: If soil particles become encased with iron they are protected from washing. Thus he says we may get laterites high in silica. Of course I pointed this out a long time ago, and this fact explains the mistakes made by Pendleton and others trying to reason from total analyses of lateritic crusts.

Aubert speaks on the hydromorphic soils of French West Africa.

Today I have an excellent lunch chez Focan along with Prof. van Straelen.

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Today I have an excellent lunch <u>chez</u> Focan along with Prof. van Straelen.

At the afternoon session Mr. Chenery gives an interesting paper on the acid sulphate soils in Central Africa. He discusses some swampy soils that once dried have a pH of 1.0 due to the sulphur accumulated through drainage from surrounding hills. Five tons of lime and 220 pounds of superphosphate make it possible to produce crops with a water table at one to two feet.

Near the end of the session we have a short seminar on the "dark horizon", all in French language! Out of it I get the following suggestions:

1. It is a characteristic of soils on several parent materials.
2. It occurs on soils of widely varying slope.
3. Most of the soils having the dark horizon vary in altitude between 1,700 and 2,600 meters.
4. There is disagreement about the vegetation. In the Belgian Congo it has not been found under high forests but it has been found under high forests in Uganda.
5. Whereas, the carbon-nitrogen ratio of organic matter in the A_1 is about 12, and of that in the A_2 between 10 and 12, that of the dark horizon is between 15 and 18.

After the session several of us go to the home of the American Consul-General, Mr. McGregor, for cocktails. With him I arrange that our Dr. Ruhe get immediate passage by plane to the United States since he has had a bad attack of stomach ulcers.

After dinner and talk with Bradfield, Charter, and Brammer I'm to bed at 10:30 p.m.

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August 21

This morning we have the last formal session of the Congress.

Dr. Buringh gives another paper on reconnaissance soil exploration from the use of aerial photographs. I think he has been much influenced by previous criticisms and doesn't follow his mimeographed paper closely but includes many more basic qualifications. I ask him if he would not be willing to make the changes that include these very important qualifications prior to formal publication in the Proceedings. He says he will. We shall see.

I take a little time out to get some more money exchanged. The general efficiency of the Belgians breaks down completely on any sort of banking work. This has not changed since my previous visit.

We then have an ad hoc seminar on soil classification.

Mr. Charter presents his ideas that I try to write down in outline somewhat as follows:

Soils are products of their environment and thus, unlike many other objects mapping is needed for their study. I agree.

He suggests that we be careful not to break too completely with the past in any new system.

He again asserts that the genesis of a soil is one of its characteristics. This I find very confusing.

Charter says that he bases his system on the definitions of Neustruev.

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Charter says that he bases his system on the definitions of Neustruev.

He emphasizes three categories corresponding roughly to order, suborder, and great soil group.

He accepts the Russian concept illustrated by the form:

$$\text{Soil} = \int \begin{array}{l}\text{climate, vegetation, relief and} \\ \text{drainage, parent material, age.}\end{array}$$

I. Climato-phytic soils

A. Pedalfers

B. Pedocals

(Charter says these terms are hard to define. (Of course, we have dropped them because they cannot be defined!) The occurrence of pedocals in the Tropics has been exaggerated, he says.)

II. Topo-climatic soils

High altitudes in the Tropics

III. Topo-hydric soils

A. Deprescio soils

B. Clino soils

(He illustrates by a strongly sloping colluvial deposit connecting an inselberg with the lower plain where the calcium carbonate horizon exists only in soils of the lower part of the slope connecting the inselberg with the plain beneath.)

C. Planosols

D. Cumulo soils

E. Hydrosols

(He regards these as soils <u>below</u> water with vegetation growing in the presence of sunlight.)

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He subdivides his A group into acid gley, neutral gley, calcium Solonchak, and sodium Solonchak. He would have similar subdivisions for groups D and E and possibly for C and B.

IV. Lithochromic earths

These soils are dominated by parent material because of their youth. He includes Lithosols, Regosols, Rendzina, Brown Forest, etc.

At the conclusion of Charter's statement I give a general description of what we are trying to do in the revision of our scheme of soil classification and discuss the broad categories that include tropical soils. I agree that we will send out copies of our next approximation to those who should like to see it when it has been developed following the conferences in Europe next September. Several urge that we include a glossary for any terms that are not defined in the Soil Survey Manual.

On the whole I think we have a useful discussion.

I return to the hotel and start my packing for the field trip beginning early August 23. When I go to pay for my laundry I discover that a shirt has been destroyed. I offer to accept $2 for damage; the hotel manager offers me $7; and we settle for $3. This is quite the reverse of usual arguments about such things.

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Then I go to the final plenary session at which Prof. Oudin is elected as president and Prof. Henin as vice-president of the Society. The invitation to have the Sixth International Congress in Paris in 1956 had already been accepted.

After dinner I go with several others to the Park de Bock for a program of Congolese native dances (See Appendix, 13). These are very colorful, primitive, and interesting. I stay for three dances, each of which is very long. The same theme is repeated over and over and over. I leave before the program is finished and get to bed about 11:30.

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August 22

In the morning one of the men comes from the American Consulate and picks up some of my books and papers to be forwarded home and some to be held for my return visit to Leopoldville.

A little later we take a boat trip on the Congo River. This is very pleasant and gives everyone an opportunity to relax, visit with his friends about the Congress, and take photographs. We land at Brazzaville and take a short trip to see a new hydroelectric power dam and a research station on fish growing.

The whole trip was fine but a little bit long. I rush through a late dinner and finish my packing for early morning.

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K-2228 Aug. 22, 1954. Belgian Congo. A glimpse of the quay at Leopoldville.

K-2229 Aug. 22, 1954. Belgian Congo. On the Congo River at Leopoldville.

K-2228 Aug. 22, 1954. Belgian Congo. A glimpse of the quay at Leopoldville.

K-2229 Aug. 22, 1954. Belgian Congo. On the Congo River at Leopoldville.

K-2230 Aug. 22, 1954. Belgian Congo. (L to R) van Baren, Tavernier, Ignatieff, and Walter Russell.

K-2231 Aug. 22, 1954. Belgian Congo. (L to R) Scarseth, Jurion, and Bradfield.

K-2232 Aug. 22, 1954. Belgian Congo. (L to R) Jurion, H. Harper, L. B. Nelson.

K-2233 Aug. 22, 1954. Belgian Congo. (L to R) Bradfield, Scarseth.

K-2234 Aug. 22, 1954. Belgian Congo. (L to R)_____, C. F. Charter.

K-2235 Aug. 22, 1954. Belgian Congo. Edelman.

K-2234 Aug. 22, 1954. Belgian Congo. (L to R) _____,
C. F. Charter.

K-2235 Aug. 22, 1954. Belgian Congo. Edelman.

K-2236 Aug. 22, 1954. Belgian Congo. Focan.

K-2237 Aug. 22, 1954. Belgian Congo. (L to R) Jurion, Harper.

K-2238 Aug. 22, 1954. Belgian Congo. Ignatieff.

K-2239 Aug. 22, 1954. Belgian Congo. Lebrun.

K-2239 Aug. 22, 1954. Belgian Congo. Lemurian.

K-2240 Aug. 22, 1954. Belgian Congo. Congo River boat.

K-2241 Aug. 22, 1954. Belgian Congo. The "buffet" on the boat.

K-2240 Aug. 22, 1954. Belgian Congo. Congo River boat.

K-2241 Aug. 22, 1954. Belgian Congo. The "buffet" on the boat.

K-2242 Aug. 22, 1954. Belgian Congo. The "buffet" on the boat.

K-2243 Aug. 22, 1954. Belgian Congo. Congo River boat.

K-2242 Aug. 22, 1954. Belgian Congo. The "buffet" on the boat.

K-2243 Aug. 22, 1954. Belgian Congo. Congo River boat.

CONGO BELGE ET RUANDA-URUNDI

STATIONS D'ADAPTATION LOCALE ENSEIGNEMENT AGRICOLE ET STATIONS DE L'INEAC

ECHELLE

50km 0km 50 100 150km

AFRIQUE ÉQUATORIALE FRANÇAISE

SOUDAN ANGLO-EGYPTIEN

UGANDA

TANGANYIKA TERRITORY

RHODESIE

ANGOLA

OCEAN ATLANTIQUE

LAC TANGANYIKA

LAC ALBERT

LAC MOERO

LAC BANGWEOLO

L. LEOPOLD II

L. VICTORIA

L. Edouard

Baya
Lola-Zongo
Bodangabo
Bwamanda
Boketa
Banza Sud
Bongabo
Likimi
Binga
Ndeke Epate
Mondongo
Alberta (H.C.B.)
Lisala
Bumba
Busu Djanoa
Basankusu
Eala
COQUILHATVILLE
Ingende
L. Tumba
Bikoro
Inongo
Mushie
Jardinier
LEOPOLDVILLE
Kimwenza
Luala
Gombe Matadi
Jardinier Kisantu
Gungu
Ngeba
Maunzi
Mvuazi
Zomfi
Mbembe Luidi
Kondo
Gimbi
Boma
Luki
Kikwit
Kiaka
Mbao
Vuemba
Mutangu
Bondo
Wapinda
Masomea
Buta
Tukpwo
Bambesa
Angodia
Bangadi
Niangara
Paulis
Nzangi
Dubele
Wamba
Mt Hawa
Gabu
Lekwa
Nioka
Pimbo
Bunia
Irumu
Adusa
Banalia
Barumbu
Yahuma
Elisabetha
Gazi
Yangambi
Bengamisa
Batwasende
STANLEYVILLE
Ndihira
Butembo
Luhotu
Lubango
Boende
Bokoto
Bokondji
Yakolela
Batiengo
Obokote
Walikale
Kisuma
Goma
Ruhengeri
Kigali
Guisaka
Mulungu
Tshibinda
Kabare
BUKAVU
Bugesera
Nyamyaga
Rubona
Astrida
Parambo
Tubarika
Buenzi
Luvungi
USUMBURA
Karuzi
Kitega
Kisozi
Kininya
Baruti
Buniambirira
Mukumari
Ipami
Omendjadi
Kindu
Salubezia
Kisamba
Tongoni
Kibanqula
Lubefu-Kasongo
Bena Longo
Luebo
Lusambo
LULUABOURG
Kamwandu
Kasanza
Kabinda
Kamponde
Gandajika
Gadi
Kaniama
Niembo
Leya
Albertville
Baudouinville
Kalewe
Kamina
Songe
L. Upemba
Kabangu
Kilwa (Pêche)
Lufira
Kaseji
Dumba
Jadotville
Keyberg
ELISABETHVILLE

LEGENDE

ENSEIGNEMENT

- Enseignement supérieur à créer
- Ecoles des assistants agricoles
- Ecoles des assistants agricoles à créer
- Ecoles professionnelles agricoles
- Ecoles professionnelles agricoles à créer

STATIONS

I.N.E.A.C.
- Station principale
- Stations en fonctionnement
- Stations à créer

COLONIE S.A.L.
- Stations d'adaptation locale
- Stations d'adaptation locale à créer

Agent agricole détaché à une station I.N.E.A.C.

par la Section Cartographie et Cadastre
nistère des Colonies — Janvier 1954

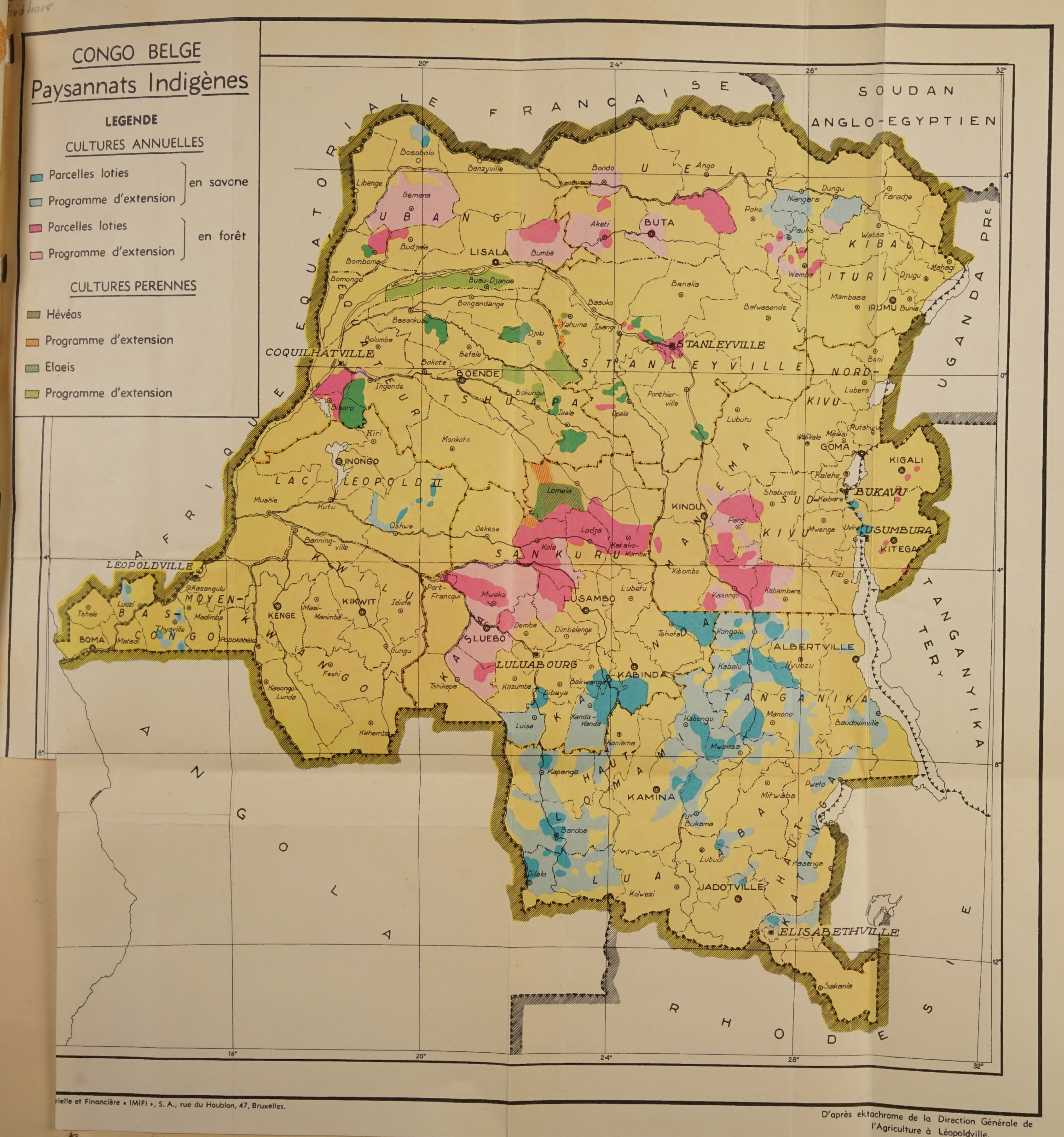
Renseignements fournis par la Direction de l'Agriculture du Ministère des Colonies

K-2244 Aug. 22, 1954. French Equatorial Africa. Brazzavil
Cathedral Inside.

K-2245 Aug. 22, 1954. French Equatorial Africa. Brazzavil
native quarter.

K-2244 Aug. 22, 1954. French Equatorial Africa. Brazzaville Cathedral inside.

K-2245 Aug. 22, 1954. French Equatorial Africa. Brazzaville native quarter.



rielle et Financière « IMIFI », S. A., rue du Houblon, 47, Bruxelles.

D'après ektachrome de la Direction Générale de l'Agriculture à Léopoldville.

August 23

I'm up at 4:45 a.m. for final packing and I get the special train for the Low Congo, leaving at 6:00 a.m.

We stop at Kiasi-Col (or Kiazi-Col). Here we get into buses and drive through a part of the M'Vuazi-Kokozi forest reserve (See Guide Sheet in the Appendix).

At the first bus stop we look at the Kiazi-Col series. This is a brown, deep, very young soil from limestone. The B horizon (if it has a B) has an angular, medium to coarse blocky structure with a yellowish red color (5YR 4/6). Our guides call this a Yellow Latosol from limestone. Actually the soil material is mixed limestone, shale, and sandstone on very steep slopes. It is most too young to have the genetic name they have given it. On the whole we should regard this as an A-C soil with a faint and discontinuous B. The associated Alluvial soils seem highly productive and have fair crops of bananas without fertilization. I'm told that they normally use the following general kinds of rotations:

1. Peanuts, beans, and maize; or cassava, peanuts, and maize.
2. Beans or peanuts with maize, and sometimes bananas.
3. Cassava.
4. Same as either 1 or 2.
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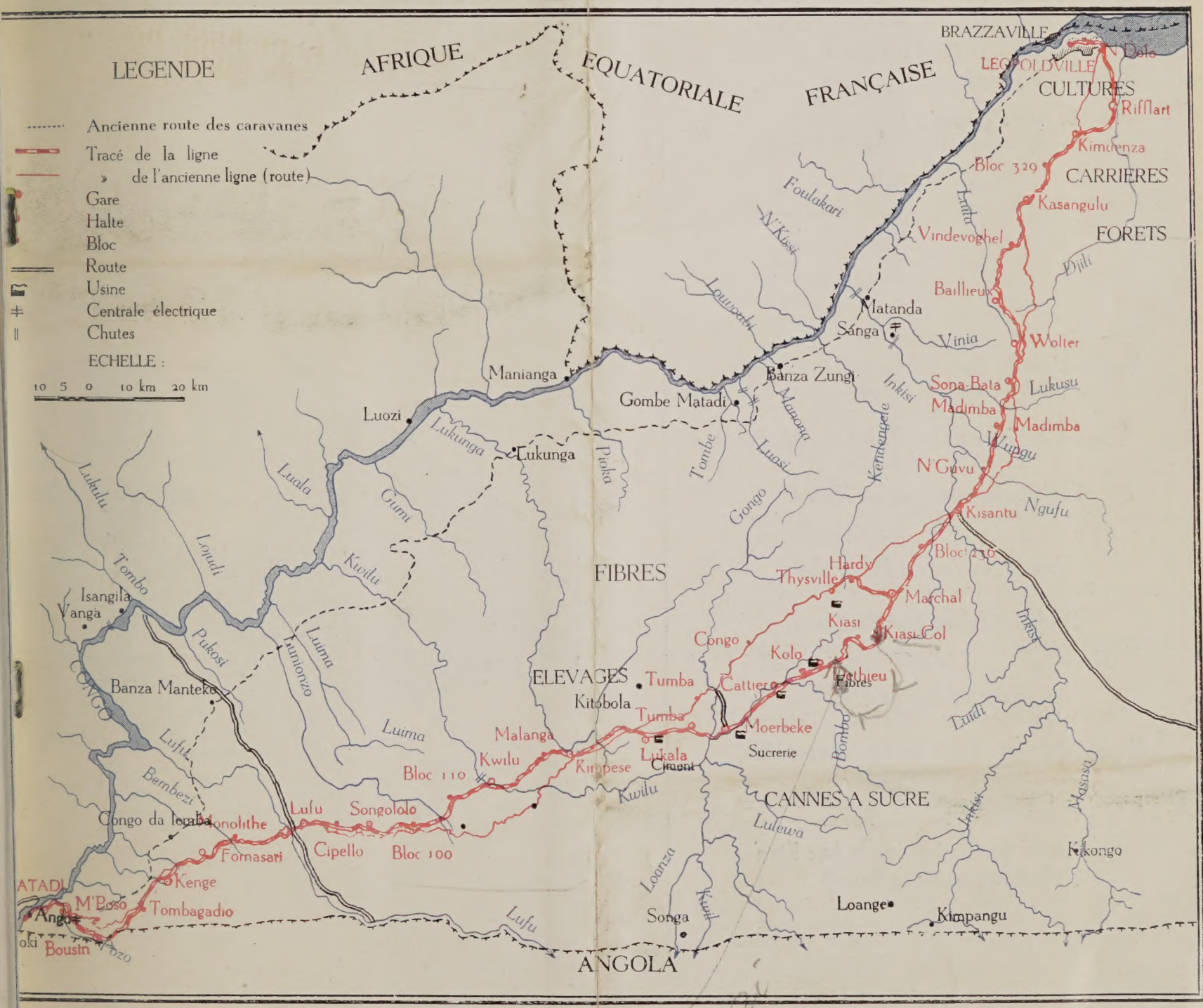
TRACÉ DU CHEMIN DE FER MATADI-LÉOPOLDVILLE



OFFICE D'EXPLOITATION DES TRANSPORTS COLONIAUX AU CONGO

"OTRACO"

VOIES FLUVIALES, CHEMINS DE FER, LAC KIVU ET PORTS

Siège : 101, Avenue Louise - Bruxelles

Direction générale à Léopoldville
8, avenue Emile Banning

Voies Fluviales

Direction à Léopoldville, 10, avenue de la Douane. — Services directs sur le Fleuve et le Kasaï. — Services auxiliaires sur les affluents en correspondance avec les services directs.

Agences : Léopoldville - Aketi - Banningville - Basankusu Basoko - Bena-Dibele - Bumba - Coquilhatville - Kutu - Libenge - Lisala - Lomela - Luebo - Lusambo - Pania-Mutombo - Port-Francqui - Stanleyville - Kikwit.

Exploitation du Port Public de Léopoldville

Entreposage - Chargement et déchargement - Réception Dédouanement.

Chemin de Fer de Matadi à Léopoldville

Direction à Thysville.

Exploitation du Port de Matadi

Entreposage - Assurances - Chargement et déchargement de navires - Réception - Dédouanement.

Chemin de Fer du Mayumbe

Boma - Tshela - Direction à Lukula.

Exploitation du Port de Boma

Entreposage - Assurances - Chargement et déchargement de navires - Réception - Dédouanement.

Chemin de Fer du Kivu

Kalundu - Kamaniola - Direction à Kalundu.

Exploitation des Ports de Costermansville, Goma et Kalundu

Entreposage - Chargement et déchargement de navires Réception - Dédouanement.

Service de navigation sur le Lac Kivu (Costermansville - Goma)

Bureau commercial : Léopoldville, 8, avenue Emile Banning
Ce bureau se tient à la disposition du public pour fournir tous renseignements se rapportant aux transports sur tous les réseaux de la Colonie.

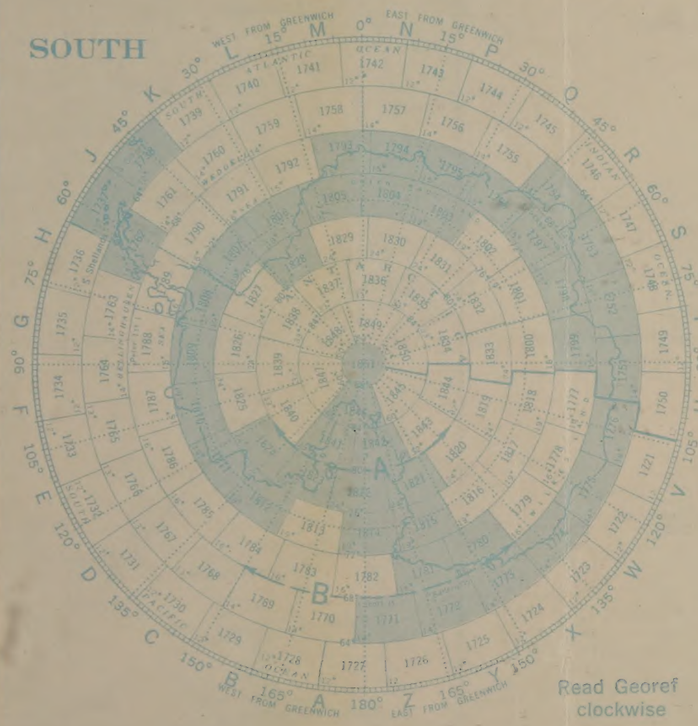
L'Otraco assure le service des connaissements directs A.M.I. dans les localités suivantes : Léopoldville (port public) - Stanleyville (rive droite) - Bumba - Basankusu - Coquilhatville - Lusambo - Libenge - Luebo - Lisala - Banningville - Kikwit - Aketi - Kalundu - Goma - Costermansville.

Editions L. CUYPERS, Bruxelles.

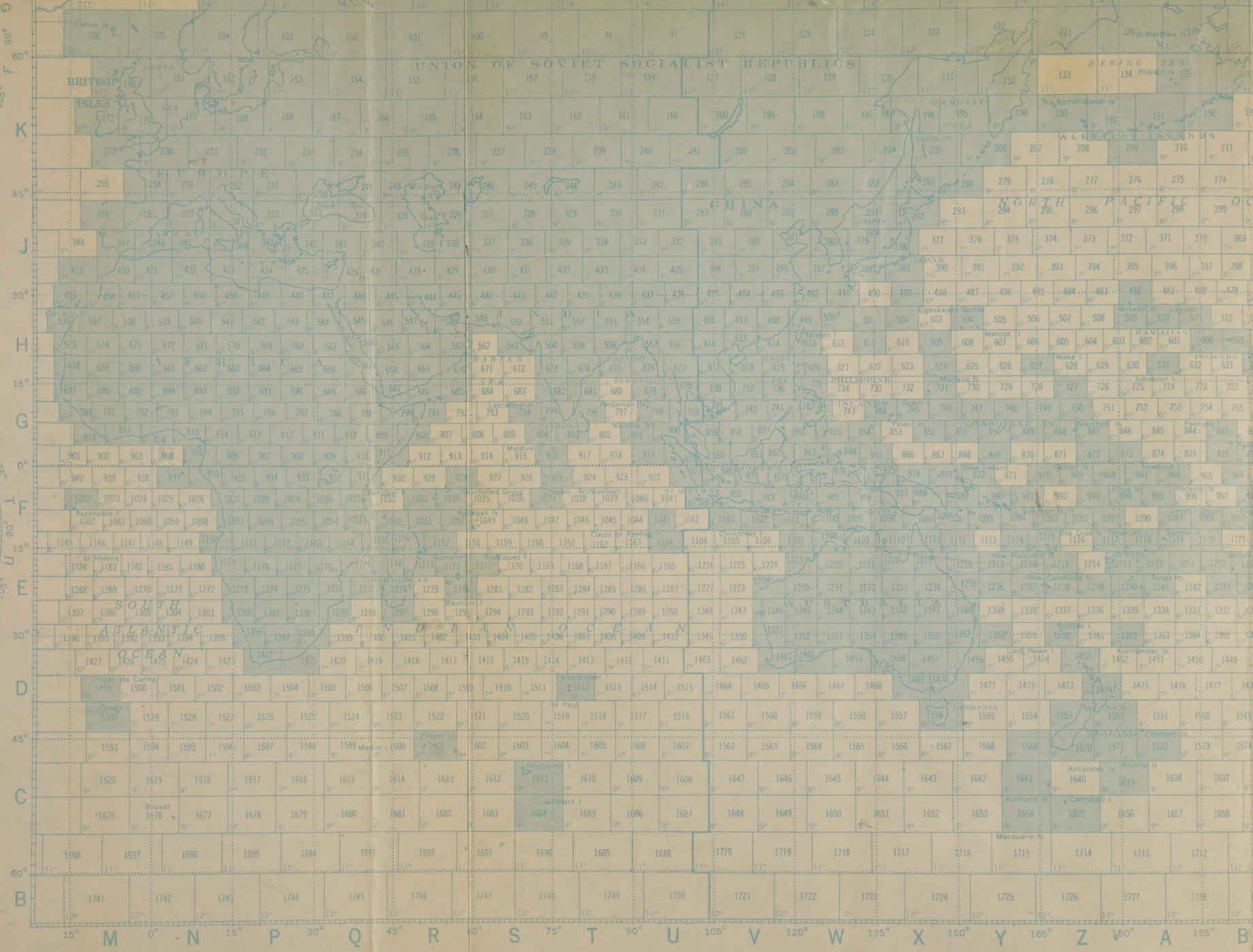

FRENCH EQUATORIAL AFRICA
BELGIAN CONGO
CABINDA (ANGOLA)
BELGIAN CONGO
ANGOLA (PORTUGAL)
CONGO
NIARI
Loudima
Loubomo
DOLISIE / 35
1155
LOUDIMA / 39
535
Madingou
Kayes
Bouenza
Kimbedi
Loulombo
Mindouli
Tibounyama
Matoumbou
Kibouende
Kimbanda
Mouyondzi
Mouniamboula
R Bn
DOLISIE
R Bn
BRAZZAVILLE
DF
BRAZZAVILLE
BRAZZAVILLE
BRAZZAVILLE / 39
1099
MAYA MAYA / 75
1047
Ile M'Bamu
KINSHASSA
LÉOPOLDVILLE
R Bn
LEOPOLDVILLE
LEOPOLDVILLE / 65
971
Binza
Banseke
Kilambo
Kimpoko
Maluku
Djoue
Kinkala
Boukoezo
Boukonzo
Kanda
Kita Mantchie
Somaka
Kasangulu
Mbuba
Sanda
Lala
Tampa
Binanga
Boko
Kinduudi
Nsona Bata
Madimba
Kimpako
Kisantu
Kinanga
Lemfu Mission
Kibambi
Mpese
Zanza
Mbansa Mpangu
Banza
Yunga
Malele
Kibombo
Kinanga
Tumbamani
Kindopolo
Kimpangu
Rio Zad
Loukouni
Foulakari
falls
Boko Songo
Kingoye
M'Pika
Manga-Kala
Micongo
Kimongo
Pounga
M'Vouti
Chimpeze
Belize
Bunga
Conde Malundo
Vinda
Ncuto
Tshela
Vito
Dinge
Maduda
Kinkenge
Ganda Kulu
Mangembo
Kikanda
Boko
Bela
Bongo
Gombe
Kinkuzi
Gombe
Matadi
Nsanda
Kenge
Pangu
Luozi
LUOZI / 32
755
Dunga
Lukunga
Kanda
Zundu
Kongo
Koma
Mukimbungu
Kasi
Bamba
Vaku
Seke
Banza
Isanga
Kinganga
rapids
Pelo
Luvituku
Kitobola
Kunda
Tumba
THYSVILLE / 26
2431
Thysville
LUKALA / 26
1312
Lukala
Kimpese
Luenika
Kinsoka
Banza Makuta
Kwilu
Songololo
Sambo
Kiende
Mongo
Kumba
Luvo
Kikeba
Pinda
Buela
Cipelo
Lufu
Kungu
Kenge
Luanika
Kimpamba
Kuyfu
Nqui
Banza
Vivi
MATADI / 30
1148
1965
MATADI
R Bn
MATADI
BOMA / 45
164
Seke dia Vunga
BOMA
Binda
Umpuelo
Bunga
Quinga
Quincanda
Lembe
Lefunde
Ngemba
Chinde
Impanga
Santo António do Zaire
ZAIRE / 33
Quiquito
Sumba
Porto Rico
Quissacala
Banana
Moanda
Maka
Kimbanza
Malela
Ile de Mateba
Kai Dunda
Bonga
Itumba
Salele
Tshoa
Chimbuande
Ngelesi
Povo
Lukula
Kimpala
Sungu
Bonde
Lela
Seke
Kikonzi
Fuiki
Kisundi
Luki
Tshilulu
Kizulu
Kingangadu
Sanda Samuna
Kwimba
Banza Manteke
Kimpa
Lela
Lubuzi
Chiloango
Loango
Loudima
Loamba
Loémé
Lucali
Niari
Rio Lue Grande
Rio Lue Pequeno
Rio Lue Baquele
Rio Lunguegi
Rio Luvo
Luanga
Luanza
Luhuanze
Luhuanze
Lukenie
Lukenie
Kwilu
Congo
falls
rapids
falls and rapids
11°W
São Salvador do Congo
Cuimba
Maguela do Zombo
Quibocolo
Beu
PL
PK
QL
QK
AL
AK
5°
6°
10
20
30
40
50
330
30

Read Georef counter clockwise

SOUTH



Read Georef clockwise



GEOREF INFORMATION

Complete information on World Geographic Reference System (Georef) is available in AFR 96-5.

Georef portrayed hereon is merely a guide for chart user to select the WAC upon which a given Georef point may be found, (example HJLC 1117) which falls on WAC 412.

1. Locate 15° quadrangle "HJ" on chart reading right to "H" and up to "J". (Dotted lines indicate 15° Georef quadrangles.)

2. Locate 1° quadrangle "LC" within 15° quadrangle "HJ". (See sample quadrangle breakdown in lower left corner.)

3. Locate 1 minute intersection "1117" within 1° quadrangle "LC" of "HJ" quadrangle. (See sample quadrangle breakdown in lower left corner.)

4. "Interchart Relationship" index should be used to determine the PC and AC chart upon which the Georef reference point falls.

AERONAUTICAL SYMBOLS

AERODROMES

AERODROMES WITH FACILITIES

SEAPLANE LANDPLANE

Military

Civil

WHEN AERODROME PATTERNS ARE USED THE FOLLOWING SYMBOLS APPLY

Background includes that part

AERONAUTICAL SYMBOLS

RADIO FACILITIES

Examples of voice and CW calls are shown below

Radio Range (With voice) — RNG WOODY RADIO 291 ABC

Radio Range — RNG WILLOW RANGE

Radio Communication Station (With voice) — CS GOWEN AIRWAYS 4765


N.V.
Kiasi-col
105
Kobe
Lambu
Kilemba
Lombo
Kimuinga
23
Sona Kituani
21
Kinda
Lukuakua
23
21
Senga
Putu

After a 5-year cropping system the land is usually fallowed for about 8 years. Since there is strong pressure for productive land here sometimes they break it out too soon, say after only 4 years of bush fallow.

On the young Alluvial soils the peasants use a short rotation with elephant grass in the fallow.

We take a quick look at the Lombo series - a latosolic Lithosol. We are also shown a cherty phase with the same kind of profile developed on strong slopes from mixed colluvium.

The dust is simply terrible on these country roads in the dry season. We come into the M'Vuazi Experimental Station and see a deep cut and profile in fairly old alluvium. No true genetic soil profile features can be seen except for an organic mat and for horizontal banding representing various periods of stream overflow.

We have a wonderful lunch at the M'Vuazi Station. INEAC has built several large laboratories and other buildings since I was here some 7 years ago. At that time this was primarily a fruit station but since then they have added research on food crops, cattle breeding, and more basic work in soil science and plant physiology.

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K-2246 Aug. 23, 1954. Belgian Congo. Near M'Vuazi. Small termite mound with double roof.

K-2247 Aug. 23, 1954. Belgian Congo. Boarding the train at Dethiew for Matadi.

K-2246 Aug. 23, 1954. Belgian Congo. Near M'Vuazi. Small termite mound with double roof.

K-2247 Aug. 23, 1954. Belgian Congo. Boarding the train at Dethlem for Matadi.

I'm told by the director that native workers here receive about 25 cents per day in take-home pay in addition to housing, medical services, blankets, and allowances for food and clothing plus some allowance for wives and children. The total cost to INEAC is about 50 cents per day per worker, which is considerably more than they had received when I was here before.

After lunch we go into the buses and start back toward the railway.

We make a hurried stop to look at the M'Baka series, which is very close to soil No. 41 in my bulletin on the Congo published by INEAC. The soil here is a Yellow Latosol grading toward a Ground-Water Laterite.

A_1	0-16"	Dark gray clayey soil with irregular medium cloddy structure (10YR 3.5/2).
A_2	16-30"	Yellow clayey soil, mottled (10YR 6/6). There are many small concretions.
B_1	30-45"	Clayey soil, brown (7.5YR 5/5) with many concretions which are red when broken. These concretions have the general form of the old rock fragments but have weathered and since weathering have rehardened. This gives a mass of soil with the appearance of coarse, hard granular structure.
B_u	45-50"	Cherty stone-line.
B_3	50-76"+	Yellowish-red clayey laterite, mottled with shades. Fairly soft but compact. This material hardens to hard laterite when dry.

(I see Kubiena taking a sample in the least representative part of a long cut.)

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(I see Kubiena taking a sample in the least representative part of a long cut.)

We pass a private cattle ranch of about 100,000 hectares that carries around 20,000 cattle. The breed is said to have been introduced from Nigeria. The cattle are called M'Dumas. They are medium dusky brown in color. They are in good flesh now despite the dry appearance of the pasture. I had an excellent steak from this ranch at the luncheon of the American Club in Leopoldville last week.

We drive back to the railway and take the train for Matadi about 7:15 p.m. at Dethieu Station.

As we go on south most of the cover is savanna and most of this has been burned. There is some poor gallery forest along the drainways.

We are rather late and travel a long way in the dark. After dinner on the train some try singing over the loud speaker, but the results are only successful enough to keep us awake, except perhaps for Major Ignatieff's rendition of Aloutte, which goes something like this:

Aloutte, gentie aloutte,
Aloutte je te plumerai.
Je te plumerai la tête,
Et la tête.
O! aloutte, gentie aloutte --
Repeat: Add: la bec, les yeux, la bouche,
les orielles, etc.

We reach Matadi about 8:30 p.m. and I'm taken to the Hotel Metropole.

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Vers Kionzo
Vers Boma
PLATEAU DE VIVI
Vers Kizulu-Sano
Vers Vivi
Lufu
Tshimpi
Aerogare
Banc de la Lufu
Banc rocheux de Stanley
Ile Kalawanga
Pointe Léopold II
Fleuve Congo
VENISE
Gare
Prison
Camp des Policiers
Ravin Léopold II
CITE
ZANZA THYS
KITOMESA
LES BAOBABS
BRUXELLES NORD
BRUXELLES SUD
NOUVEL ANVERS
Matadi
FUKA FUKA
KALA KALA
Ravin de Kala Kala
Ravin de la Poubrière
UNDERHILL
Ravin de l'Hôpital
Belvédère de Kinkanda
Belvédère (Table d'orientation)
Monument aux porteurs
Mpozo
Camp Militaire de Matadi
EGLISE KINKANDA
TEMPLE MISSION SUEDOISE
KINKANDA
Abattoir
Ferme de Kinkanda
Pompage Mpozo
Pompage Kinzao
Ravin d'Ango Ango
CHAMP DE TIR
Kinzao
PIC CAMBIER
Régideso Soyo
Ravin Construcol
Camp Militaire d'Ango Ango
Ravin de Ngombe
Soyo
Vers Loadi
ANGOLA
Noki

August 24

We are up for an early breakfast in order to leave by car for an excursion north of Matadi into that part of the Low Congo called the Mayumbe.

We drive rather rapidly past the Gimbi Station up to an area that is being reforested with the use of bananas as a nurse crop. Contracts are let by the government for planting the bananas and seedlings of Terminalis surperba. After about 6 years of bananas the seedlings take over. In this way the government gets the area reforested and the contractor gets the bananas. (See Appendix, 16)

A very large trench has been prepared for examination of the soil. It extends from the top of one ridge, down the slope, and up the opposite slope to the top of another ridge. This is a real pedological extravaganza. I hurry to get pictures and to start an examination ahead of the main group. The first hill has a soil that probably belongs with the Red Latosol group but represents the first intergrade toward Yellow Latosol. At station 9, I check the pH and get readings as follows: At 2", pH 4.7; at 10", 4.9; at 30", 5.0; and at 50", pH 5.2.

The material in the profile is relatively uniform. The B horizon is red clay (2.5YR 4/6). The soil is slightly darker in the surface and somewhat brighter beneath the B. Soil has irregular, medium blocky structure.

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K-2248 Aug. 24, 1954. Belgian Congo. Matadi from north of river.

K-2249 Aug. 24, 1954. Belgian Congo. About 7 miles north of Gimbi. A small irrigated native vegetable garden (cabbage, carrots, tomatoes, onions, lettuce) on alluvial soil associate of Yellow Latosol.

K-2248 Aug. 24, 1954. Belgian Congo. Matadi from north of river.

K-2249 Aug. 24, 1954. Belgian Congo. About 7 miles north of Gimbi. A small irrigated native vegetable garden (cabbage, carrots, tomatoes, onions, lettuce) on alluvial soil associate of Yellow Latosol.

K-2250 Aug. 24, 1954. Belgian Congo. About 15 miles north of Gimbi. Bananas and forest planting on Red Latosol.

K-2251 Aug. 24, 1954. Belgian Congo. About 15 miles north of Gimbi. Bananas and forest planting on Red Latosol.

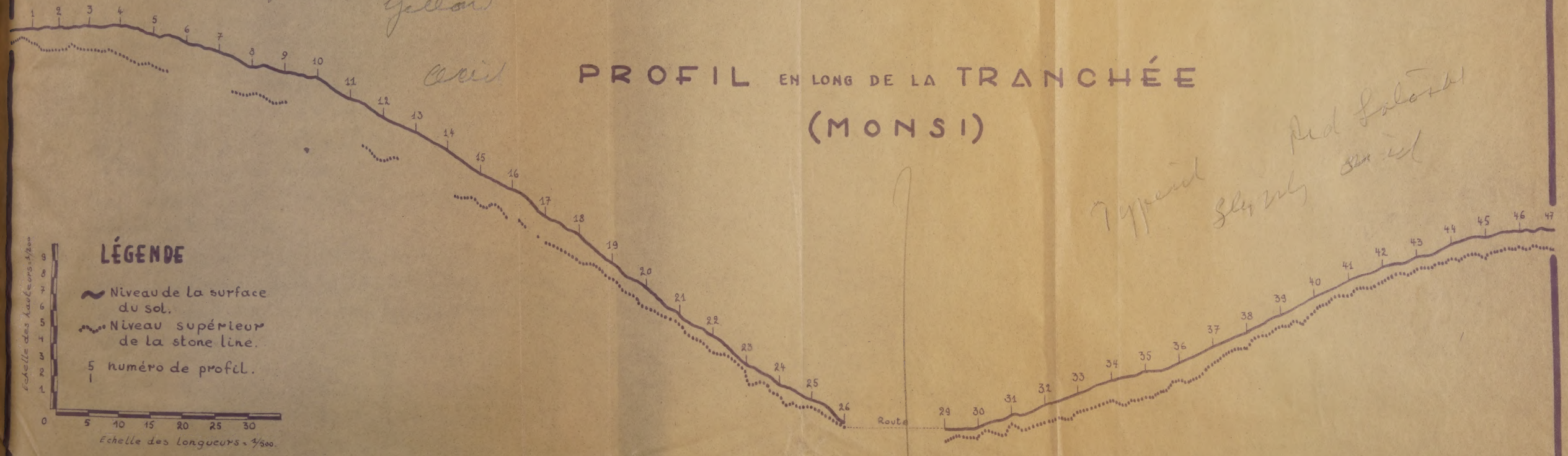
CENTRE FORESTIER DU MAYUMBE

INEAC - LUKI

V.e CONGRÈS INTERNATIONAL
DE LA SCIENCE DU SOL

Excursion I - 2.e Partie
24 août 1954

PROFIL EN LONG DE LA TRANCHÉE (MONSI)



I go down this slope and then up the opposite slope to station 46 and look more carefully at a Red Latosol (K2252):

A_3	8-11"	Transitional
B_2	11-40"	Dusky red to red clay (10YR 3/4 to 7.5R 3/4). The soil digs out as medium angular blocky. There is some vertical cracking and many small root channels. The color is somewhat more dusky in the upper part.
B_{3u}	40-56"	The soil is similar to the above except for a large amount of quartz of gravel and cobble size that represents the stone-line.
B_3 or C	56-80"+	Rotten amphobole schist. The material is generally dark red (2.5YR 3/6) with slight mottling with brighter red, yellow, and olive.

The pH values that I get are about as follows: At 3-1/2", pH 6.4; 16", 5.6; 30", 5.6; and at 56", pH 6.3.

This profile is near the top of a rounded hill where the slope is around 8 percent. (The attached chart indicates the variation in the stone-line).

This is certainly a most interesting place. This last profile is a characteristic Red Latosol and only slightly acid, whereas the soil of the opposite slope is the first intergrade from Red Latosol toward Yellow Latosol.

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As I go down the slope toward the low place between the two hills, I notice there are many roots in the stone-line. Although irregular, the stone-line is nearly continuous here and lies well above the top of the C. The surface soil becomes a bit darker and perhaps more compact. At station 29, near the bottom, the soil above the stone-line is shallow and is a dark, reddish brown clay (2.5YR 3/4).

It is said that bananas here yield around 6 tons per hectare. Then after a short time the planted forest trees take over. I realize that this is a low yield according to well-managed plantation standards; yet the nurse crop of bananas is certainly a valuable one.

What a trench! I'm told that it took 50 natives 10 days to prepare it.

We drive on south over the same road and stop for a splendid lunch at the Gimbi Station.

After lunch and a few "pretty speeches" we go over to look at the sisal plots on Yellow Latosol where experiments have been conducted with fertilizer and lime. (K2253). I think it was Dr. Alexander that had suggested to me that this soil, described in some detail in my Congo bulletin, may have been developed from old volcanic ash. I worked hard to find evidence for this but could not. I have no idea what could be the origin of the material except the usual plain formation under normal erosion cycles, which must have taken place a long time ago.

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K-2252 Aug. 24, 1954. Belgian Congo. About 15 miles north of Gimbi. Profile of Red Latosol. Note stoneline at about 40 inches.

K-2253 Aug. 24, 1954. Belgian Congo. At Gimbi. Sisal fertility plots shortly after harvest on Yellow Latosol.

K-2252 Aug. 24, 1954. Belgian Congo. About 15 miles north of Gimbi. Profile of Red Latosol. Note stoneline at about 40 inches.

K-2253 Aug. 24, 1954. Belgian Congo. At Gimbi. Steal fertility plots shortly after harvest on Yellow Latosol.

We drive on and stop at a very deep cutting that gives an exposure of massive, relatively loose, lateritic material described in a special INEAC bulletin by Waegeman. He says that this material was formed in place, but I doubt this, and so do most of the others. Aubert has a special name for this material that has been moved somewhat. He calls it "gravillons lateritic du nape de plateau." He regards the accumulation of iron in this material as a "relative" accumulation.

I get some pictures here and try for a few more on our way back to Matadi. We must get to the Congo River well before dark. Because of the many whirlpools people are not allowed to cross in the ferry except in the daylight.

I get back to the Metropole around 6 p.m., and fortunately I am able to organize some hot water for a much needed bath after this day in the heavy dust.

We all have dinner together followed by some stories, singing, and a few "pretty speeches."

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K-2254 Aug. 24, 1954. Belgian Congo. South of Gimbi. Characteristic umbrella trees (one of the very best for fallow).

K-2254 Aug. 24, 1954. Belgian Congo. South of Gimbi. Characteristic umbrella trees (one of the very best for fallow).

August 25

After a fairly early breakfast I go out on the street and buy some tobacco and some folding scales like those I got here a few years ago with inches on one side and centimeters on the other.

We board the train for Leopoldville about 9:05 a.m. I try for pictures along the way, of course, this is always a risky business.

We journey on slowly all day, with time to write and to visit. We get back to our hotels in Leopoldville about 7:00 p.m. I rearrange my baggage for the trip to Stanleyville and get to bed early in anticipation of another early start in the morning.

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K-2255 Aug. 25, 1954. Belgian Congo. View a few miles east of Matadi.

K-2256 Aug. 25, 1954. Belgian Congo. Aubert on train.

K-2255 Aug. 25, 1954. Belgian Congo. View a few miles east of Matadi.

K-2256 Aug. 25, 1954. Belgian Congo. Aubert on train.

K-2257 Aug. 25, 1954. Belgian Congo. Village near railway east of Matadi.

K-2258 Aug. 25, 1954. Belgian Congo. Between Matadi and LeopOldville. Sugarcane.

K-2257 Aug. 25, 1954. Belgian Congo. Village near railway east of Matadi.

K-2258 Aug. 25, 1954. Belgian Congo. Between Matadi and Leopoldville. Sugarcane.

K-2259 August 25, 1954. Belgian Congo. Between Matadi and Leopoldville. View from train in sugarcane area.

K-2259 August 25, 1954. Belgian Congo. Between Matadi and Leopoldville. View from train in sugarcane area.

August 26:

I'm up at 6:00 a.m. and arrange my baggage for the trip to Stanleyville and leave some packages in the hotel.

At 7:30 a.m. we go by a very crowded Sabena bus to the air field. As usual, Tavernier is up late and almost misses the bus. We are put in a very large plane and leave at 9:00 a.m.

After passing over a Kalahari sand area and one of heavier soils that are covered partly with savanna but mostly with forest, we go for several hundred kilometers over nearly solid equatorial rain forest. A large part of this is wet or swampy, especially in the season of greatest rain in the upper watersheds. (But the flow of the Congo River varies less than those of many big streams because of the distribution of its tributaries between the northern and southern hemispheres.)

The plane circles Yangambi and we get glimpses of the layout of the various research sections and of the experimental corridor systems of shifting cultivation.

We arrive in Stanleyville about 2:30 p.m. Fortunately, my baggage is off first and I go to the Sabena Hotel directly across the street. I have a nice room and a little rest.

At 4:30 p.m. we are taken for a tour along the river and especially out to the very margin of Stanley Falls. Many of the natives have dressed themselves in costume for our benefit. After a little while at Stanley Falls we go out to Tshopo Falls where a

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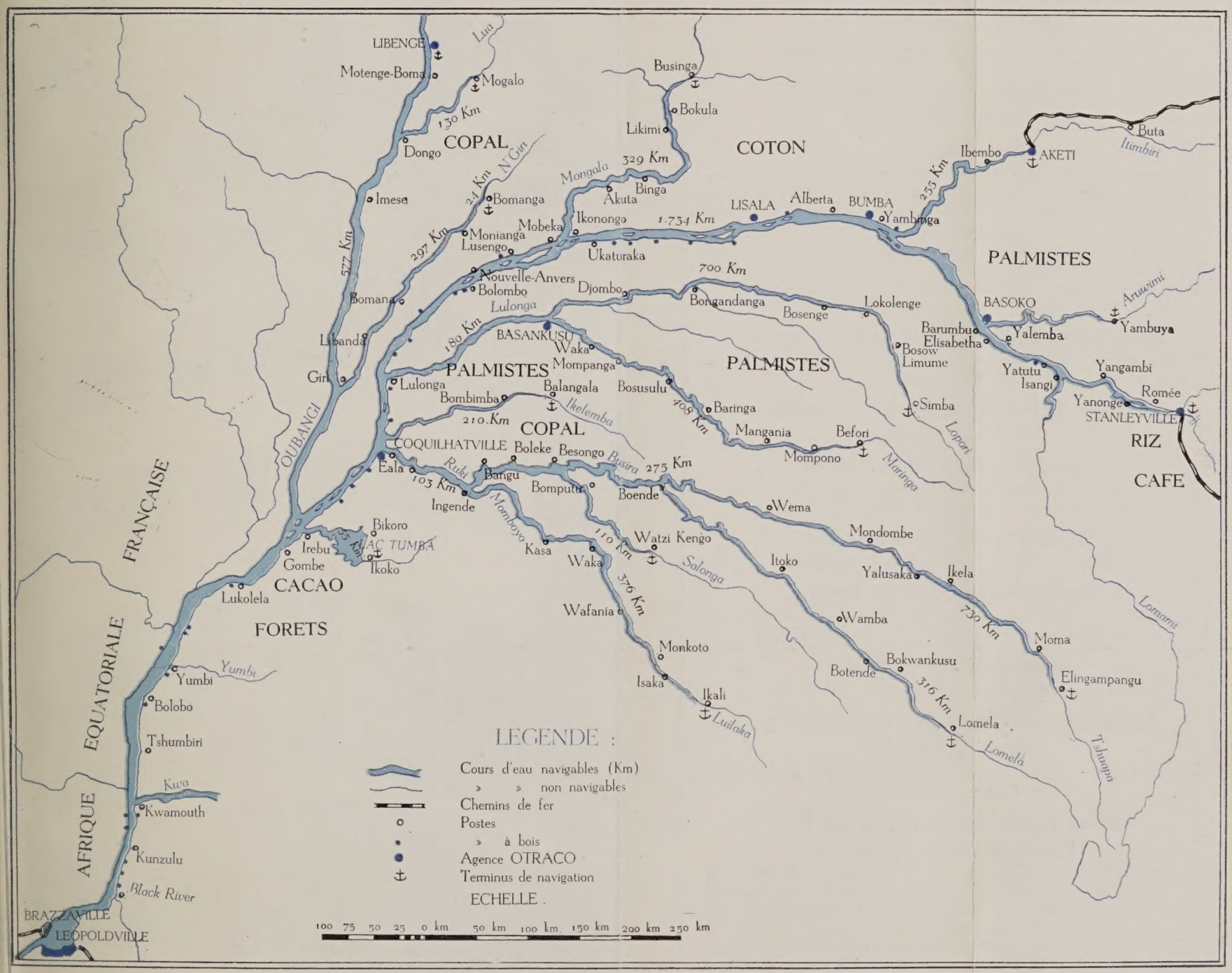
LIGNES DE NAVIGATION SUR LE FLEUVE CONGO ET SES AFFLUENTS



OFFICE D'EXPLOITATION DES TRANSPORTS COLONIAUX AU CONGO

"OTRACO"

VOIES FLUVIALES, CHEMINS DE FER, LAC KIVU ET PORTS

Siège : 101, Avenue Louise - Bruxelles

Direction générale à Léopoldville
8, avenue Emile Banning

Voies Fluviales

Direction à Léopoldville, 10, avenue de la Douane. — Services directs sur le Fleuve et le Kasaï. — Services auxiliaires sur les affluents en correspondance avec les services directs.

Agences : Léopoldville - Aketi - Banningville - Basankusu Basoko - Bena-Dibele - Bumba - Coquilhatville - Kutu - Libenge - Lisala - Lomela - Luebo - Lusambo - Pania-Mutombo - Port-Francqui - Stanleyville - Kikwit.

Exploitation du Port Public de Léopoldville

Entreposage - Chargement et déchargement - Réception Dédouanement.

Chemin de Fer de Matadi à Léopoldville

Direction à Thysville.

Exploitation du Port de Matadi

Entreposage - Assurances - Chargement et déchargement de navires - Réception - Dédouanement.

Chemin de Fer du Mayumbe

Boma - Tshela - Direction à Lukula.

Exploitation du Port de Boma

Entreposage - Assurances - Chargement et déchargement de navires - Réception - Dédouanement.

Chemin de Fer du Kivu

Kalundu - Kamaniola - Direction à Kalundu.

Exploitation des Ports de Costermansville, Goma et Kalundu

Entreposage - Chargement et déchargement de navires Réception - Dédouanement.

Service de navigation sur le Lac Kivu (Costermansville - Goma)

Bureau commercial : Léopoldville, 8, avenue Emile Banning Ce bureau se tient à la disposition du public pour fournir tous renseignements se rapportant aux transports sur tous les réseaux de la Colonie.

L'Otraco assure le service des connaissements directs A.M.I. dans les localités suivantes : Léopoldville (port public) - Stanleyville (rive droite) - Bumba - Basankusu - Coquilhatville - Lusambo - Libenge - Luebo - Lisala - Banningville - Kikwit - Aketi - Kalundu - Goma - Costermansville.

Editions L. CUYPERS, Bruxelles.

new hydroelectric plant is almost completed. I saw this site in 1947 when the area was mostly wooded; the grade sticks had just been set for the large engineering work that now dominates the whole area.

Just at dusk we go back on the same very rough road to the Sabena Hotel. It is warm here and a shower is very good indeed. After a fair dinner in a most lovely dining room I am early to bed.

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K-2260 Aug. 26, 1954. Belgian Congo. Stanley Falls.

K-2261 Aug. 26, 1954. Belgian Congo. Stanley Falls.
More distant view.

K-2260 Aug. 26, 1954. Belgian Congo. Stanley Falls.

K-2261 Aug. 26, 1954. Belgian Congo. Stanley Falls.
More distant view.

K-2262 Aug. 26, 1954. Belgian Congo. Stanley Falls.

K-2263 Aug. 26, 1954. Belgian Congo. Stanley Falls.

K-2264 Aug. 26, 1954. Belgian Congo. Dugout canoes near Stanley Falls.

K-2264 Aug. 26, 1954. Belgian Congo. Dugout canoes near Stanley Falls.

Stanleyville. Fish traps at Stanley Falls

View of Stanley Falls

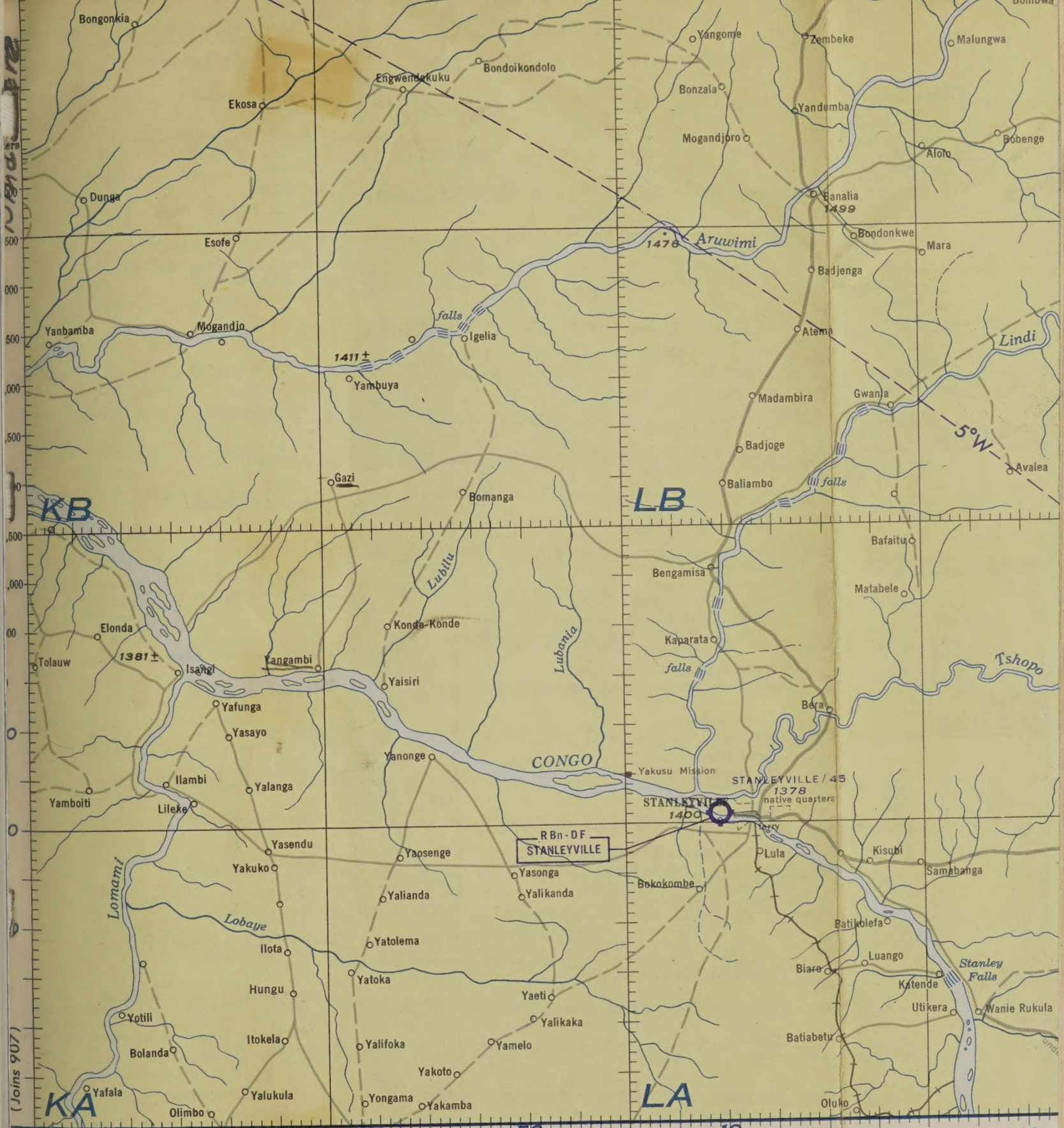
XXVIII a

K-2265 Aug. 26, 1954. Belgian Congo. New hydroelectric dam near Tschopo Falls at Stanleyville.

K-2266 Aug. 26, 1954. Belgian Congo. On the Tschopo River in the late evening.

K-2265 Aug. 26, 1954. Belgian Congo. New hydroelectric dam near Tschopo Falls at Stanleyville.

K-2266 Aug. 26, 1954. Belgian Congo. On the Tschopo River in the late evening.



TO REFERENCE BY THE GEOREF (SHOWN IN BLUE) TO MINUTES
Select Nearest Intersection South and West of Point
Sample Point: PANGA
1. PG identifies basic 15° quadrangle
2. MB identifies 1° quadrangle
3. 25 identifies Georef minute of longitude
4. 50 identifies Georef minute of latitude
5. Sample reference: PGMB2550

24°K 25°L

NAUTICAL MILES

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WASHINGTON 25, D. C.
MARCH 1948 (AMS-AM) Revised MAY 1952 (ACIS) BASE NO. 3R

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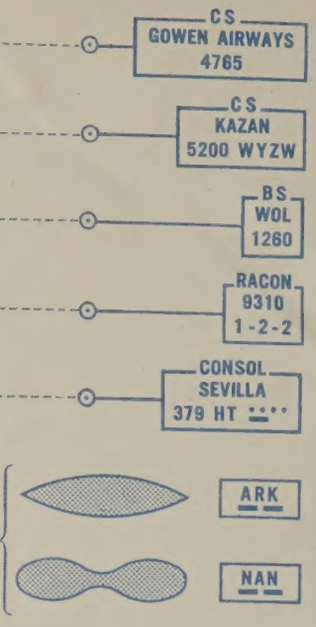

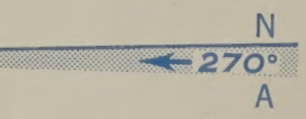

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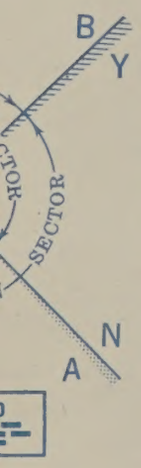
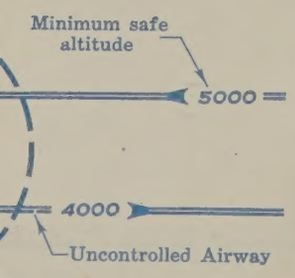




TOPOGRAPHICAL SYMBOLS

CITIES and TOWNS

Metropolitan Areas — NEW YORK

Large Cities — RICHMOND

Cities — ARLINGTON

Small Cities — SANGATE

Large Towns — Corville

Towns & Villages — Arcola

HIGHWAYS and R

Dual Lane Highways

Primary Roads

Secondary Roads

Trails

U. S. Road Markers

National, State or Provincial Road Markers

Road Names

RELIEF FEATURES

Contours
- Reliable
- Depression
- Approximate

Bluffs, Cliffs & Escarpments

Sand
- Dunes
- Areas
- Ridges

HYDROGRAPHIC FEATURES

Swamps & Marshes

Mud & Tidal Flats (Exposed at low tide)

Fathom Line (Dots uniformly spaced) (1 fathom, 6 ft. below mean low water level)

Danger Line (Dots grouped in pairs) (2 fathoms, 12 ft. below mean low water level)

Charted Rocks

Sand Bars (Exposed at low tide)

Springs

Wells & Water Holes

Reefs, Coral & Rocky Ledges (Awash at low tide)

Streams & Rivers
- Perennial
- Intermittent
- Probable or Unsurveye
- Unclassified
- Braided

Intermittent Lakes

Drainage Ditches

Canals
- In use
- Abandoned

Flood Marked Areas

Sand Deposits

Dry Washes

Glaciers

CULTURAL and MISCELLANEOUS

Power Transmission Lines

Telephone & Telegraph Lines

Dams

Elevations (In feet)
- Highest in a General Area (Highest on chart is devoid of tint)
- Spot

Mines and Quarries

Mountain Passes

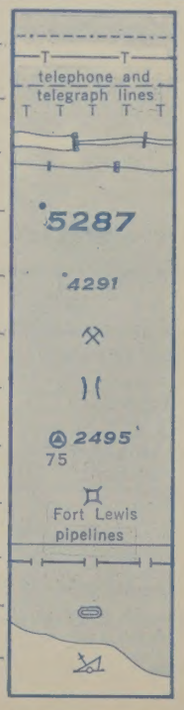
Lookout Towers (Elevation is base of tower) (Height above ground)

Forts

Pipelines

Race Tracks

Stranded Wrecks



Boundaries
- International
- State & Provincial*
- Intercolonial & Interterritorial
- Defacto

* The same as Intercolonial symbol on some char

Railroads
- Abandoned or Under Construction
- Single Track
- Double Track
- Sidings & Spurs
- Overpass
- Underpass

Bridges
- Railroad
- Highway

Tunnels
- Railroad
- Highway

August 27:

About 2:00 a.m. there is a typical roaring tropical thunderstorm with hard rain. It still rains a bit when I get up for breakfast at 6:45.

I go with the others to the river boat about 9:00 a.m. and we are soon on our way to Yangambi. This is a very pleasant trip. Although cloudy and little rainy, the air is cool. We have beautiful views along the river and this is a good time to talk with one's friends.

As we near Yangambi we are met by welcoming natives in very crowded canoes. They waive flags and sing. Some of the canoes are filled entirely with women in their colorful clothing. As the boat lands we have an uproarious welcome.

Dr. Bradfield and I go to the home of Mr. Laudelout where we are to stay during our visit. His wife and children are now in Belgium. We come back to the headquarters for a short session of explanations of the work at this main station and African headquarters of the INEAC. The natives do not want to leave and Jurion says they will not need to if they will stay quiet. He walks among them and admonishes them to be good. Obviously, Jurion loves them and they love him. But it is a bit too hard for them to be quiet after so much excitement with so many white strangers around.

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K-2267 Aug. 27, 1954. Belgian Congo. Sabena Hotel, Stanleyville.

K-2268 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.

K-2267 Aug. 27, 1954. Belgian Congo. Sabena Hotel, Stanleyville.

K-2268 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.

K-2269 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.

K-2270 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.

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K-2270 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.

K-2271 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.

K-2272 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.

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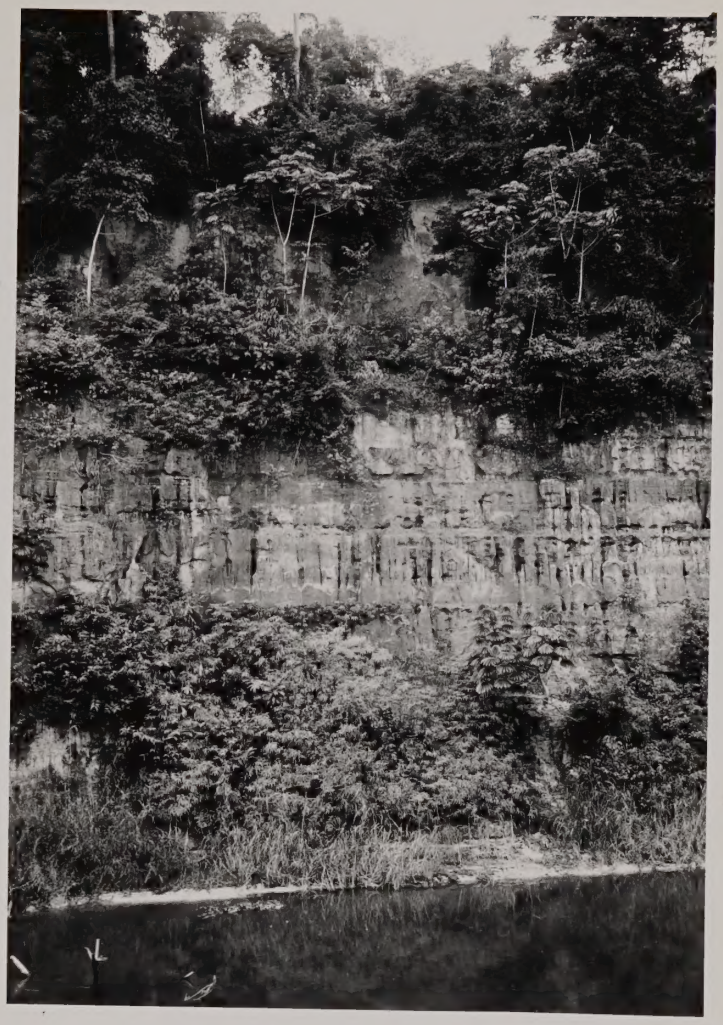
K-2273 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanelyville.

K-2274 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanelyville.

K-2273 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.

K-2274 Aug. 27, 1954. Belgian Congo. View on Congo River below Stanleyville.



K-2275 Aug. 27, 1954. Belgian Congo. Near Yangambi. Bank of the Congo.

K-2276 Aug. 27, 1954. Belgian Congo. Forested bank of the Congo near Yangambi.

K-2275 Aug. 27, 1954. Belgian Congo. Near Yangambi. Bank of the Congo.

K-2276 Aug. 27, 1954. Belgian Congo. Forested bank of the Congo near Yangambi.

K-2277 Aug. 27, 1954. Belgian Congo. Welcoming canoe.

K-2278 Aug. 27, 1954. Belgian Congo. Welcoming canoes.

K-22717 Aug. 27, 1954. Belgian Congo. Welcoming canoe.

K-22718 Aug. 27, 1954. Belgian Congo. Welcoming canoes.

K-2279 Aug. 27, 1954. Belgian Congo. Part of welcoming party at Yangambi.

K-2280 Aug. 27, 1954. Belgian Congo. Part of welcoming party and boat at Yangambi.

K-2279 Aug. 27, 1954. Belgian Congo. Part of welcoming party at Yangambi.

K-2280 Aug. 27, 1954. Belgian Congo. Part of welcoming party and boat at Yangambi.

K-2281 Aug. 27, 1954. Belgian Congo. Part of welcoming party at Yangambi.

K-2282 Aug. 27, 1954. Belgian Congo. Part of welcoming party at Yangambi.

K-2281 Aug. 27, 1954. Belgian Congo. Part of welcoming party at Yangambi.

K-2282 Aug. 27, 1954. Belgian Congo. Part of welcoming party at Yangambi.

M. LeCompte starts the proceedings. He explains that the station has 25,000 hectares of land. Then Laudelout outlines the programs of soil research and agronomic research. de Henzelin, a geologist, speaks very well, alternately in English and French, and draws the geological diagram on the blackboard showing the history of the area as he goes along! Evrard, a botanist, gives us an orientation lecture in French and M. Liben gives the English version.

I go back to the room for a brief rest and to dress for dinner, chez LeCompte. Dinner is very nice. I tell Jurion that I believe that the welcome by the natives was primarily for him rather than for the Congress. Jurion says no, it was primarily for the Congress; but Prof. van Straelen agrees with me.

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I.N.E.A.C.
ENTRE DE RECHERCHES
DE YANGAMBI
ECHELLE 1:50.000-E
ESSAI COMMUN
MBOLE
N
Palmiers
Hevea
Hevea
CLIMATOLOGIE
KM 5
S. R. A.
POSTE
CENTRE
MEDICAL
MISSION
Lusambile
Palmiers
FERME
Hevea
YANGAMBI
PAVILLONS
GUEST-
-HOUSE
Hevea
MAISON
DU DIRECTEUR
GENERAL
Isalowe
LABO
PHYTOPATHOLOGIE
YAOSUKA
BAC
FLEUVE
CONGO

August 28:

Immediately after breakfast on the boat we go to look at some soils near the river. The sky is overcast and the soil quite wet from another rain last night. First we stop to look at a large quarry having a lower layer of yellowish-red to reddish-brown lateritic gravel that is being removed for road material. Mixed in are other coarse and clayey materials besides the lateritic pebbles laid down with them as general alluvium. Above the lateritic layer is sandy colluvium that has slipped down from the wind-deposited cover on the plateau. It is thought that this upper material was laid down during early Pleistocene times, perhaps some 500,000 years ago.

We pass Yakonde village, cross the Boonde River, and pass Oblioto village. As we go along, Laudelout tells me that at some time between 2 and 18 years after starting, the amount of leaves in the forest is nearly constant. As the forest grows, the amount of wood increases, but not the amount of leaves.

He also says that the demands for phosphorus by grasses are so much greater than those by trees that there is even more total phosphorus in the dry matter of good grass fallow than in that of a forest fallow. This seems scarcely possible. He says he has reported on this in a recent paper. We cross the Lilliand River and pass a village by the same name. A little beyond we are shown an example of Ground-Water Podzol:

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A_1	0-23"	Very dark gray (10YR 3/1) structureless loamy sand with less color in the lower part.
A_2	23-38"	Light gray (10YR 6/1) structureless sand. There are here some small brownish horizontal bands about 1mm. wide and about 3 or 4 inches apart.
A_3	38-42"	Dark brown loamy sand (7.5YR 3/2)
B_2	42-50"+20"	Dark reddish-brown humus orstein (5YR 3/2)
B_3	50-52"	Transitional
C	52"+	Light olive brown (2.5YR 5/5) structureless sand.

Roots seem to penetrate the entire soil. The B_2 is irregular and absent in a few places. The soil lies on a nearly flat sandy terrace with characteristic imperfect drainage. The uncultivated soil has a very dense cover of low trees, palms, and vines. Very little light reaches the surface.

This is a productive soil with fertilizers. In fact, it seems more productive than most Ground-Water Podzols that I have seen. Experiments with fertilizers here are in their 4th year. Maize is sown in March and harvested in June. Rice grows from July to December. It was hard for me to get the detailed results here but they are in the reports of INEAC. With good husbandry the following yields were given in kilograms per hectare:

Unshelled peanuts	2,000
Shelled maize	3,000 to 3,500
Upland rice	3,000 to 3,500

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Shelled maize	3,000 to 3,500
Upland rice	3,000 to 3,500

K-2283 Aug. 28, 1954. Belgian Congo. Near Yangambi. Profile of Ground Water Podzol.

K-2284 Aug. 28, 1954. Belgian Congo. Natives near Yangambi.

K-2283 Aug. 28, 1954. Belgian Congo. Near Yangambi. Profile of Ground Water Podzol.

K-2284 Aug. 28, 1954. Belgian Congo. Natives near Yangambi.

Yangambi: Foreground: Stewart, R; Kellogg, R

Yangambi: Muir, Laudelout, Kellogg

XLa
upper

Yangambi: Foreground: Stewart, K; Kellogg, E;

XLa
lower

Yangambi: Muir, Laudelout, Kellogg

After we have looked at the soil, the natives in this village give us a welcoming dance and chant.

I look at some of the maize being hung up to dry by villagers and it looks quite good. I'm told then that it is the result of a cross made by INEAC between the local sorts and the Plata maize.

We then go down toward the river on to the alluvial plain. After so much rain this road is very difficult for the cars and buses. Here a pit is made in an alluvial soil that is tending slightly toward a Yellow Latosol.

A_o	1-0"	Dark brown
A_1	0-2"	Brown (7.5YR 4/2) plastic clay with medium granular to weak subangular blocky structure.
A_2	2-9"	Reddish-yellow (7.5YR 6/6) plastic clay with very weak subangular to angular medium blocky structure. This is a very faint A_2 horizon if indeed it is one at all.
C	9-60"+	Strong brown (7.5YR 5/6) plastic clay, with moderate medium to fine angular blocky structure in place. The soil is faintly mottled with near shades, which increases slightly with depth.

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C	9-60"+	Strong brown (7.5YR 5/6) plastic clay, with moderate medium to fine angular blocky structure in place. The soil is faintly mottled with near shades, which increase slightly with depth.

K-2285 Aug. 28, 1954. Belgian Congo. Near Yangambi. Good maize. Local strain crossed with Plata.

K-2286 Aug. 28, 1954. Belgian Congo. Near Yangambi. Vegetation on Alluvial soil, slightly intergrading to Yellow Latosol (Stobbe).

K-2285, Aug. 28, 1954. Belgian Congo. Near Yangambi.
Good maize. Local strain crossed with Pleta.

K-2286 Aug. 28, 1954. Belgian Congo. Near Yangambi.
Vegetation on Alluvial soil, slightly intergrading to
Yellow Latosol (Stobbe).

Yangambi. Kellogg and von Straelen

Yangambi. Kellogg

XLIX a (Top)

Yangambi. Kellogg and van Straelen

XLIX a

bottom

Yangambi. Kellogg

Yangambi. Charter, Ignatieff, Kellogg, Muir.

Yangambi. Ignatieff, L; Charter, R.

XLIX b

top

Yangambi. Charter, Ignatieff, Kellogg, Muir.

XLIX b

bottom

Yangambi. Ignatieff, L; Charter, R.

K-2287 Aug. 28, 1954. Belgian Congo. Termite nests on tree in wet land (Stobbe).

K-2287 Aug. 28, 1954. Belgian Congo. Termite nests on tree in wet land (Stobbe).

The soil is nearly level and has a heavy forest cover. Certainly this is a recent landscape. The roots are concentrated in the upper part, especially in the very top 2 inches. I see only a few in the 8- to 10-inch layer, and very few deeper than that. I should call this a faintly gleyed Alluvial soil tending slightly toward Yellow Latosol.

The upper cultivated soil is said to be quite acid, about pH 5.0. Yet this is probably one of the best soils in the area to support "arable farming", as that term is understood in western Europe, if properly handled. Some of this soil is being cleared. Maize yields only about 500 kilograms per hectare while rice goes up to two metric tons. Peanuts and soybeans are also grown.

We go back to the boat for lunch and in the afternoon I have a short visit to the plant physiology laboratory. Since my earlier visit they have established an elaborate experimental setup for studying the growth of plants important to the agriculture here in sand cultures with various ratios of the principal anions and cations. I see even large pots for cacao under the shade of umbrella trees. This work strikes me as a bit too theoretical and that reasoning from these sand cultures will be extremely difficult because of the enormous differences between sand cultures and soil.

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So far, however, the experiments here with oil palm suggest confirmation of my guess of 7 years ago that magnesium may be the limiting factor. But, of course, what I am most anxious to see are the results of good field experiments.

We drive through vast experimental tracts of forest, oil palm, coffee, and rubber. We stop for short explanations at a coffee-breeding station and at some of the plantings. Good results are being had with disease-resistant coffee planted after forest cutting without fire.

We continue to drive through these vast experimental areas. Of course it takes a very large area to get statistically significant results with tree crops and oil palm. And when the experiment is over one has a plantation on his hands. Here these are turned over to a separate company to operate in order to relieve the scientists of the routine administration of plantation crops.

On the way back we step over into the forest in order to have a look at the largest tree in Yangambi. The description is as follows:

Botanical name	:	Entandrophragma cylindricum
Family	:	Meliaceae
Indigeneous names	:	Libuyu, Esaka
Commercial names	:	Sapele mahogany, sapelli, aboudikro, lifaki, and libuyu

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Family : Meliaceae

Indigenous names: Libuya, Esaka

Commercial names : Sapele mahogany,

aspelit, abouthiro,

Litaki, and Libuya

Total height of the tree	151 feet
Height of the stump	62 feet
Mean diameter breast high	9 feet, 7 inches
Diameter at the middle	7 feet, 3 inches
Diameter at the top of stump	6 feet, 9 inches
Volume of the stump	3,210 cubic feet or 38,520 board feet

Just at twilight we take a quick view of the animal breeding section. I am amazed at how well this has been developed since my previous visit. They have worked out methods of producing excellent pigs economically using the local sources of food. So far they have been unable to teach this husbandry to the natives. The program has failed in one village and a second trial is likely to fail in another village. The trouble is that the villagers have customarily let their animals roam for feed. Pigs here must be kept on concrete floors. If allowed to roam into the forests they become infected with parasites. M. Jurion is quite enthusiastic about a small group of black cattle he has had from Pakistan. He thinks these will be useful in the development of breeds resistant to the Trypanosoma. Next year he hopes to get a whole shipload.

A little after dark we are back to change in order to go out again for a buffet supper and dance. At the moment I am too tired for eating my supper let alone to dance.

I persuade one of the men to take me home a bit after midnight. It was a nice party with plenty of whiskey and plenty to eat.

Total height of the tree 151 feet

Height of the stump 62 feet

Mean diameter breast high 9 feet, 7 inches

Diameter at the middle 7 feet, 3 inches

Diameter at the top of stump 6 feet, 9 inches

Volume of the stump 3,210 cubic feet or
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K-2288 Aug. 28, 1954. Belgian Congo. Yangambi experimental area. Cacao seedlings in sand cultures under umbrella trees.

K-2289 Aug. 28, 1954. Belgian Congo. Yangambi. The largest tree (Entandrophragma cylindricum) (Ignatieff)

K-2288 Aug. 28, 1954. Belgian Congo. Yangambi experimental area. Cacao seedlings in sand cultures under umbrella trees.

K-2289 Aug. 28, 1954. Belgian Congo. Yangambi. The largest tree (Entandrophragma cylindricum) (Ipwatieff).

August 29

I have breakfast on the boat with many sleepy people about.

At 8:30 a.m. I go with Donis to see the forestry work. He tells me that they have 5,000 numbered trees in the Yangambi area that are visited weekly for phenological notes including flowering, fruiting, and the like. They have specimens of the parts of these and other trees in an extensive herbarium. They also have seedlings from these trees at various stages of growth. The flowers and fruits are preserved in alcohol and they have exhibits of samples of the wood with various treatments for finishing.

He explains that a large amount of work is required in their forestry management to get rid of the "weed" trees and to promote the desirable species. He says that they have about 90 first and second class species here in the Yangambi forests. And all of these may be found on one hectare! They have also the big problem of getting into the market some of the good but still unknown species.

Some interesting sidelights grew out of the observation work. This area is very near the equator and does not have highly marked seasons. As a consequence the trees flower and reproduce at different times. One tree even lives within an eleven-month cycle rather than a full 12-month cycle so that flowering is a month earlier each year than the year before. Donis also tells me some more about Chlorophora excelsa - a calcium collector that Charter mentioned to me in the Gold Coast. He says that south of

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Leopoldville natives use the concretions of calcium carbonate in these trees to make whitewash. He says this species collects calcium even on the very sandy soils from the Kalahari sand. The big concretions are found in wounds. Generally, the calcium carbonate is distributed as tiny crystals throughout the wood.

Although he explains the layering of the primitive equatorial rain forest in somewhat the same way that Charter did in the Gold Coast for the tropical rain forest, he recognizes four layers, but without the emergent layer. These are as follows:

1. Canopy layer at 50 to 55 meters
2. Second story at 17 to 25 meters
3. First story at 8 to 17 meters
4. Shrub layer

Donis takes me into the field and shows me their experiments looking to the improvement of the old secondary forests. (It rains slightly.) They take out the bad species, ill-formed trees, and the climbers. The good species are planted in cut lines. This operation, with the planting, takes about 60 man-days per hectare. Most lines are seeded but a few are planted with transplants. He shows me some plantings by the so-called Anderson method. The basic lines are 1,000 meters long and 100 meters apart. Then between the long lines are cross lines at 20-meter intervals with little plots between the cross lines at 10-meter intervals. The little plots are 4x4 meters within the areas of 20 meters by 10 meters.

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K-2290 Aug. 29, 1954. Belgian Congo. Yangambi experimental forest. View in cut line (rain).

K-2290 Aug. 29, 1954. Belgian Congo. Yangambi
experimental forest. View in cut line (rain).

K-2291 Aug. 29, 1954. Belgian Congo. Yangambi experimental forest.

K-2292 Aug. 29, 1954. Belgian Congo. Kellogg in Yangambi experimental forest in front of termite mound.

K-2292 Aug. 29, 1954. Belgian Congo. Kellogg in Yangambi experimental forest in front of termite mound.

They also have some unmanaged or "natural" rotations under observation to study the reproduction of trees for periods of 5 to 25 years.

We go into more cut lines at 20-meter intervals planted to such things as mahogany and limbo to study their growth here at Yangambi.

Donis tells me that the forest roots go very deeply here on the very well drained soils. In one excavation a mahogany tap root was still very large at 9 meters below the surface. It is his view that in the normal equatorial rain forest on well drained soil there is as much wood below the ground as above it! This scarcely seems possible.

A little later the botanist takes me to an example of the primitive equatorial evergreen rain forest. It certainly is a beautiful woods. One of the nicest trees, Brashgstigia Laurentii, is a legume. But like many other woody legumes, the roots have no nodules and apparently no nitrogen is fixed as in clover roots. In this forest I see a series of platforms built around a very large tree. These are connected by ladders. This setup was used for a long time in order to measure the micro-climate at various levels within the forest.

Obviously, the fallen branches and leaves decompose very rapidly. Termites are abundant and the leaf litter is always thin.

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A little later the botanist takes me to an example of the primitive equatorial evergreen rain forest. It certainly is a beautiful woods. One of the nicest trees, Brachystegia laurentii, is a legume. But like many other woody legumes, the roots have no nodules and apparently no nitrogen is fixed as in clover roots. In this forest I see a series of platforms built around a very large tree. These are connected by ladders. This setup was used for a long time in order to measure the micro-climate at various levels within the forest.

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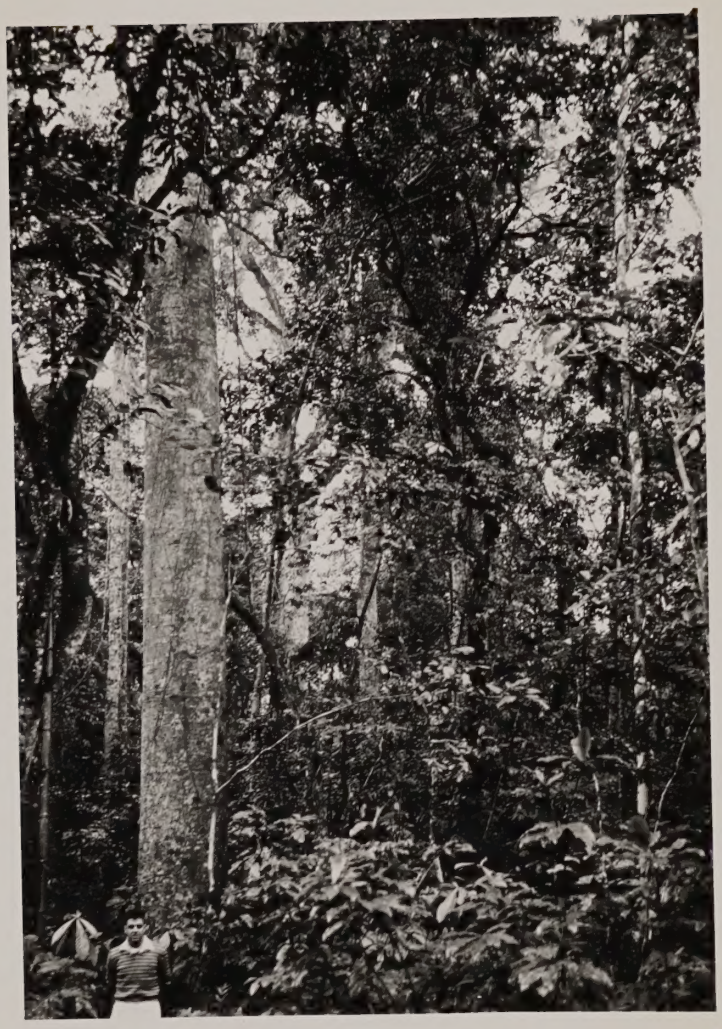

K-2293 Aug. 29, 1954. Belgian Congo. Yangambi forest reserve. Big tree is Brachystegia laurentii-- a legume without nodules - a principle compontent of climax equatorial rain forest.

K-2293 Aug. 29, 1954. Belgian Congo. Yangambi forest reserve. Big tree is Brachystegia laurentii-- a legume without nodules - a principle component of climax equatorial rain forest.

We go a bit further and pass into what is called "heterogeneous forest." It is said that the difference is due to old clearing many, many years ago. A part of the trees here are deciduous. This second forest is said to be the pre-climax stage for the first one. The principal tree is Scorodophlaeus Zenkari. I'm told that 100 years are required for the climax to replace this advanced secondary forest. The soil here is a sandy loam in the Yellow Latosol group.

On the way back I see a nice stand of a kind of substitute for alfalfa introduced from Australia. The name of it is Stilosanthis gracilis. It is growing in a cleared field. It is said to be a good crop both for fodder and for soil cover. If so, it might make possible more "arable" farming.

I go to lunch chez Donis. Another guest is Prof. van Straelen. He is an interesting conversationalist who knows a great deal about many things. We even have a short lecture on humming birds!

About 2:30 p.m. I make a brief visit with others to the Pedology Department. First we have a short explanation of the soil mapping program. I can't help but be pleased with the plans since they are proceeding along the lines I recommended during my former visit. A good deal of the soil mapping is done for the Agriculture Advisory Service, including schematic maps used in the rehabilitation of native villages.

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K-2294 Aug. 29, 1954. Belgian Congo. Yangambi forest reserve. Scorodophlaeus zenkari is main tree in very old second growth on sandy loam Yellow Latosol.

K-2294 Aug. 29, 1954. Belgian Congo. Yangambi forest reserve. Scorodophloeus zenkeri is main tree in very old second growth on sandy loam Yellow Latosol.

I get a good impression from a rapid view of the analytical laboratory. We speak a bit about sulphur. Previously I had thought that much sulphur might pass through the upland soils. I was led to this view because of the great movement of magnesium from the high lands to the low lands. I am told that recent study has shown that sulphur-accumulating plants are abundant in this forest, which tends to confirm my guess.

We also discuss the enormous amount of soil mixing which comes about through the growth and death of the trees and the micro-fauna including especially termites. Considering the enormous root development in the well drained soils, there must be a lot of mechanical movement and mixing of the soils, not counting the formation of cradle knolls by wind. The spaces left by the huge roots are apparently refilled with mineral soil as the roots die and decay, perhaps partly by termites and partly by the crowding of newly growing roots.

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In the late afternoon we all gather on our river boat to see the native boat races on the Congo River. They begin on the other side of the river and paddle across to our landing. This certainly causes a lot of excitement. Following the races there is a good deal of wild dancing by men in all sorts of queer costumes. The other natives press in from all sides to watch. All of the dancers here are men, many of whom are quite old. The whole is an interesting and colorful spectacle; and at the same time a bit horrible in its primitiveness. I remark to Jurion: "Suppose this terrific emotion, now having this interesting and harmless outlet, were directed toward political objectives?" But he says simply, "There is no possibility of it."

After changing and supper on the boat I am in bed at 8:50 p.m.

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K-2295 Aug. 29, 1954. Belgian Congo. Boat races on the Congo.

K-2296 Aug. 29, 1954. Belgian Congo. Finish of the boat race.

August 30

I'm up at daybreak after a very good night's sleep. This promises to be a fair day.

After breakfast we start on a tour to see some of the upland soils of the plateau and to see the corridors near the village of Gazi. We drive north of the Yangambi station into the area of the Iurumbu natives. Actually the native name is Olombo but the early explorers misunderstood them. We pass Weko where we see well-prepared corridors.

Our first stop is to look at the local kinds of soil that I had included with Reddish-Yellow Latosols seven years ago and that now seem to be called Yellow Latosols. With the large crowd here it is very difficult to make detailed soil descriptions and I see little to object to in the generalized one given on page 9 of the explanation on the soil map of this area. (See Appendix 20 and 21). Locally this soil is called "Series Y-1", or Yakonde. The soil is gently undulating and roots go to about 80 inches. It now has a cover of second-growth forest about 7 years old.

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A_{oo}		Very thin leaf mold.
A_o		Absent
A_{11p}	0-1"	Dark yellowish-brown (10YR 3/4) loose, granular sandy loam with small particles of black charcoal.
A_{12p}	1-9"	Brown (7.5YR 4/4) sandy clay. Nearly massive with very weak medium granular structure. Fairly sticky when moist.
A_2	9-18"	Strong brown (7.5YR 5/6) sticky plastic sandy clay with coarse sand. The horizon boundaries are diffuse. The soil is nearly massive and slightly firm. Now that the soil is wet, only with care can one remove weak, medium granular peds.
B	18-45"	Yellowish-red (5YR 5/2) sandy clay a trifle heavier than that above. The structure is about like that of the A_2, although somewhat less firm in the lower part.
C	45-60"	Strong brown (7.5YR 5/6) sandy clay. Horizon boundaries are exceedingly diffuse and the soil varies from the B only in its slightly less firmness.
C	60-80"+	Like the above but still less firm.

We can argue a great deal about the boundaries of these horizons and whether or not there is really a "B" horizon.

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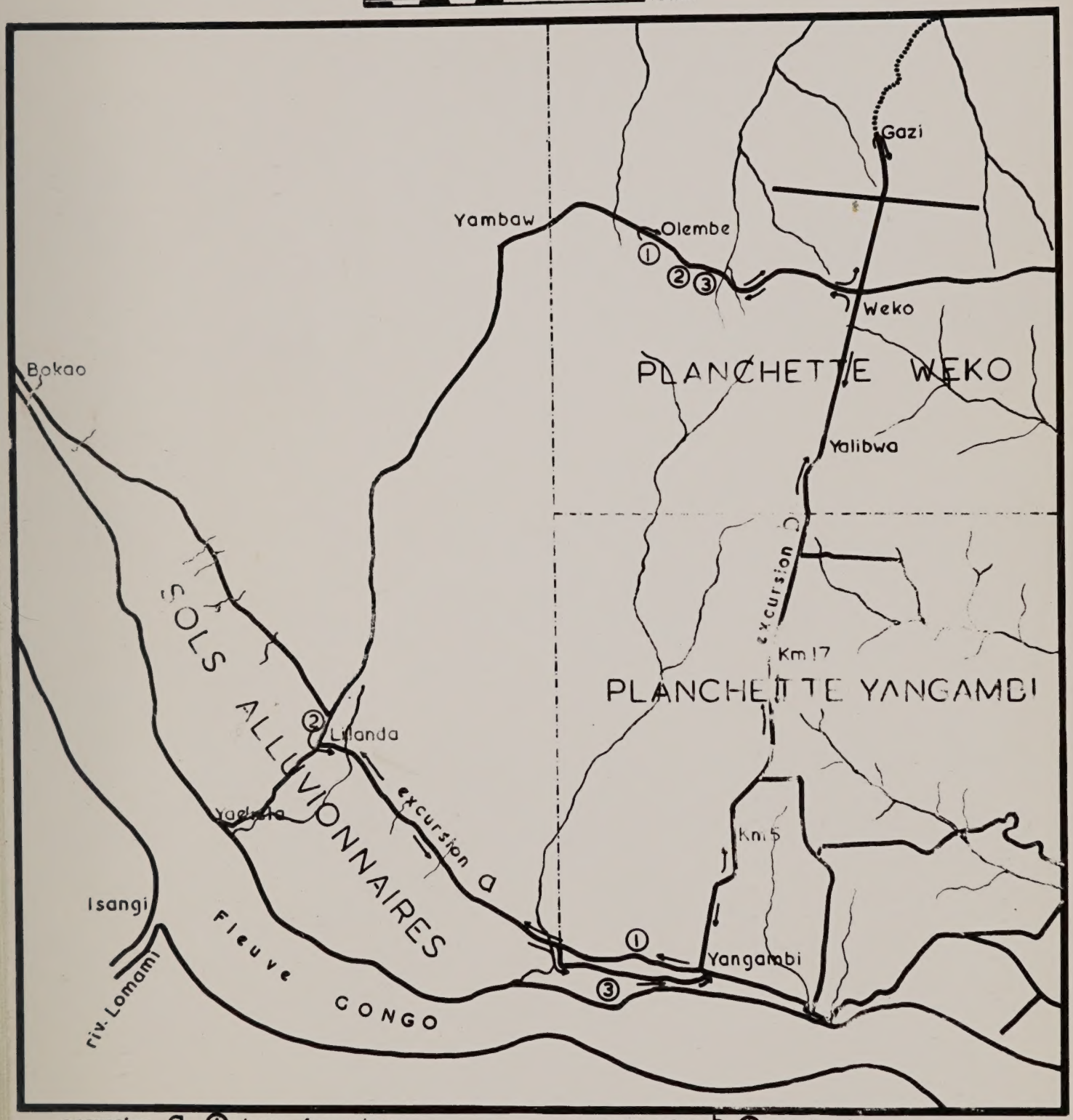
CARTE SCHEMATIQUE DE LA REGION DE YANGAMBI



excursion a
① banc ferrugineux
② profil série SP
③ profil série M_4

excursion b
① profil série Y1
② profil série Y2
③ profil série Y_3

We then go to the so-called "Y-2" soil series which varies from the first one in greater friability below a depth of one meter. The INEAC people feel that they can distinguish these soils from one another, but it looks rather difficult to me. The second soil has a slightly lower clay content and is not so firm. The local people insist that the difference is very important and that the separation can be made on the basis of texture. Here we are very close to the margin in water-supplying ability of the soil and experiments show the second soil to be inferior to the first one for oil palm, coffee, and rubber. Obviously there is great termite activity in these soils.

Vine of Nigeria says that these soils we have just seen are similar to the Calabar soils of Nigeria, except that these probably have somewhat more water.

We have a long explanation of the fallow system being followed but I am promised a more orderly statement later. I notice that the peasants are growing peanuts at the end of the crop cycle. Pedologically this is bad, but this food crop is badly needed to increase the protein content of the local diet. Then too, bananas must come into the crop cycle as soon as possible. Both rice and bananas are very important to the natives here. Maize would do better if put later in the crop cycle but since other crops are more important to the natives, maize is sown earlier even though yields are somewhat lower. Thus the actual practices followed in

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any corridor depend a great deal upon the needs of the natives as well as upon soil. It is easier to maintain soil productivity where the natives prefer cassava and bananas rather than maize or sorghum.

We make another stop at what is called the "Y-3" soils, or the Isalowe series. These soils are quite sandy and are thought to have been very dry in mid Pleistocene times, say about 200,000 to 300,000 years ago. The botanist thinks that the equatorial rain forest has not been on this soil for more than 15,000 years and perhaps even less.

In all of these soils it is clearly obvious that termites have been exceedingly active in decomposing the remains of the vegetation and in mixing the soil. Large fossil termite mounds occupy a good deal of the land surface. In places they probably take 30 percent and more of the space and have heights of 5 to 10 feet. Termites are far less active though on the very sandy soils.

We then drive into what is called INEAC N'Gazi. I notice on the way that the last stage of rubber tapping is going on here. We stop for lunch in a specially prepared pavillion with a metal roof. Off to the side in lower ground is a temporary rest room equipped with porcelain wash basins and all the other facilities, operated with running water stored in barrels outside.

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K-2297 Aug. 30, 1954. Belgian Congo. North of Yangambi on soil Y-1 a Yellow Latosol. Vegetation 7 years old (van Baren)

K-2298 Aug. 30, 1954. Belgian Congo. North of Yangambi. Inside temporary (sic) lavatory built only for use during luncheon stop of the Congress. C. F. Charter at wash basin.

It is simply remarkable how INEAC has prepared for this Congress. We have lunch with sandwiches and fruits. For the first time I have a fruit called "ramboutan". It is quite good. In size it is about like a large plum and has a soft spiny surface.

After lunch we have a short lecture on the system of farming in the adjacent villages. This work started in 1943 and is carried out chiefly by the Advisory Service backed up by INEAC. To give more room the original village was split and a new one started called Barsa. Working with the village people, the corridors were laid out to fit both the social conditions and the soil pattern. They are laid east and west in order to get maximum light. They plan to have one acre or slightly more in crop per year for each native family. Perhaps a fourth of the corridor may be in peanuts. A single man in the village gets about half as much as a family. Coffee and fruit trees are planted near the village site.

At the start very few weeds come into the corridor; but with long cropping the weed problem increases. Some of the plants that have since become weeds were great rarities in the early days.

An outline for the cropping season is roughly as follows: Assuming 18 corridors with 4 under crop and 14 under forest at some stage, the corridors are arranged so that each one in crop is bounded by corridors in some stage of forest regeneration. The trees on the new corridor are cut in December and burned during the next two months since this is the driest part of the year.

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An outline for the cropping season is roughly as follows: Assuming 10 corridors with 4 under crop and 14 under forest at some stage, the corridors are arranged so that each one in crop is bounded by corridors in some stage of forest regeneration. The trees on the new corridor are cut in December and burned during the next two months since this is the driest part of the year.

First year:

March - planting of maize

July - harvest maize

August - plant bananas and rice

September - transplant cassava

Second year:

January - harvest rice

September - harvest cassava and start banana harvest. The banana harvest continues and a second-growth of cassava comes along.

Third year:

February - harvest bananas and this is followed by further regrowth and harvest of cassava.

Fourth year:

March - plant maize

July - harvest maize

September and October - plant peanuts on one-fourth of the corridor.

December - harvest peanuts

Then the corridor is allowed to return to forest fallow for about 14 years. With other cropping systems, or on other kinds of soil, the fallow period may be longer or shorter.

We then go out to look at some of the corridors. We see one that has been in fallow for 9 years and has had the underbrush cleared away so that we might photograph the beautiful umbrella tree (Musanga Smithii). This is the best fallow tree at Yangambi according to present knowledge. We walk across several of these

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September and October - plant peanuts on one-fourth of the corridor.

December - harvest peanuts

Then the corridor is allowed to return to forest fallow for about 14 years. With other cropping systems, or on other kinds of soil, the fallow period may be longer or shorter.

We then go out to look at some of the corridors. We see one that has been in fallow for 9 years and has had the underbrush cleared away so that we might photograph the beautiful umbrella tree (Musanga Smithii). This is the best fallow tree at Yangambi according to present knowledge. We walk across several of these

corridors and see those with cassava and bananas and one with rice just coming up with cassava and bananas very small. The rice is planted in hills of 7 seeds about 8 inches apart with a dibble. This rice sowing has just followed the harvesting of maize. I notice an enormous shade effect on the bananas. The early growth is much greater along the margins of the corridor. We walk through the plantings of fruit, coffee, and oil palm into the village. Here again we are given a welcoming dance and chant.

On the way back I stop for a moment at "Kilometer 18" in order to get a photograph of exposed termite mounds. Here an attempt is being made to grow food crops with clean cultivation. I go back with Laudelout for a bath and change and then to the boat for a leisurely dinner. This has been an exceedingly pleasant and interesting day.

To bed at 10:00 p.m.

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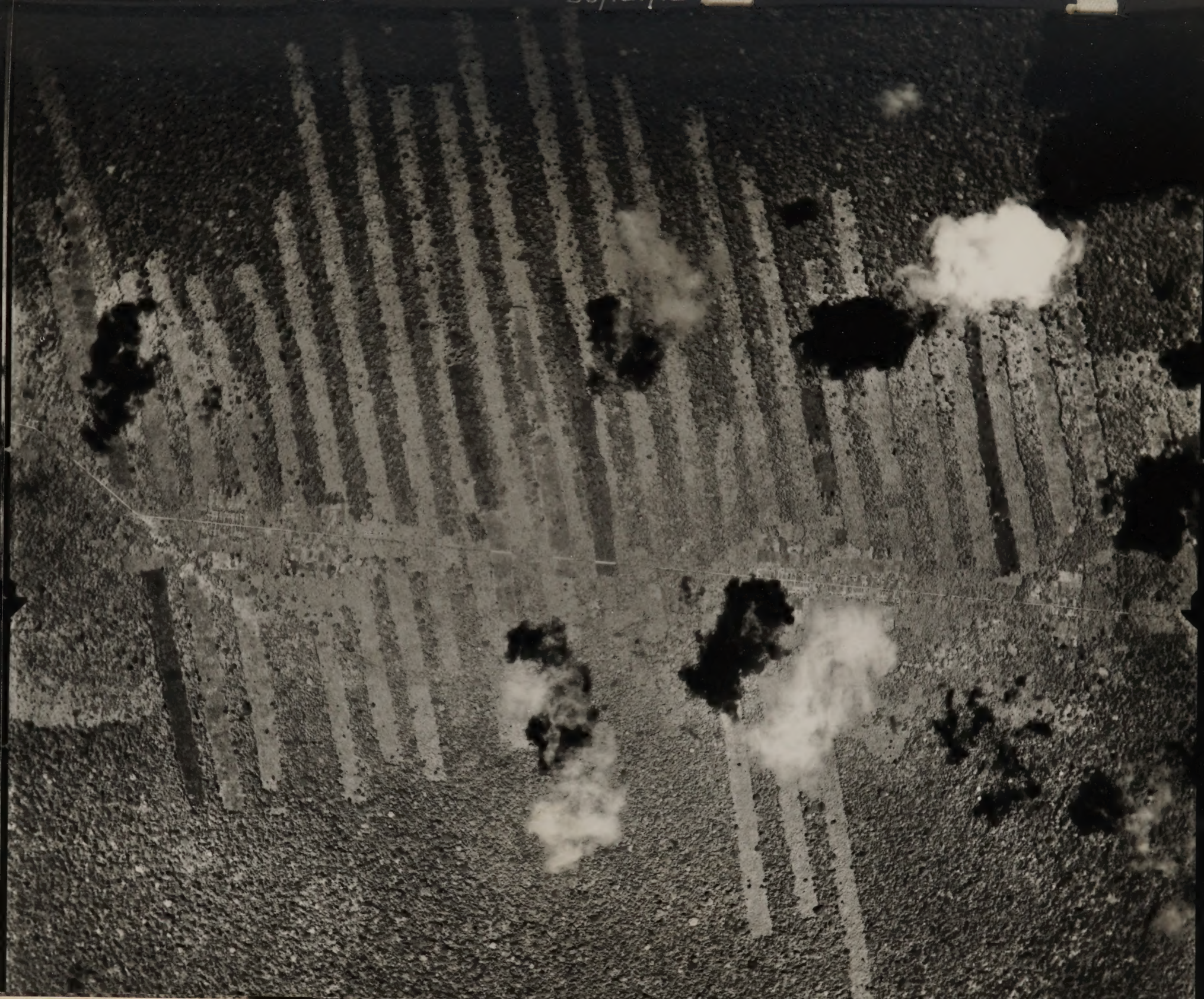
K-2299 Aug. 30, 1954. Belgian Congo. North of Yangambi. Corridor of village after nine years of forest fallow with umbrella trees - Musanga Smithii. (Underbrush cleared away for ease of photographing).

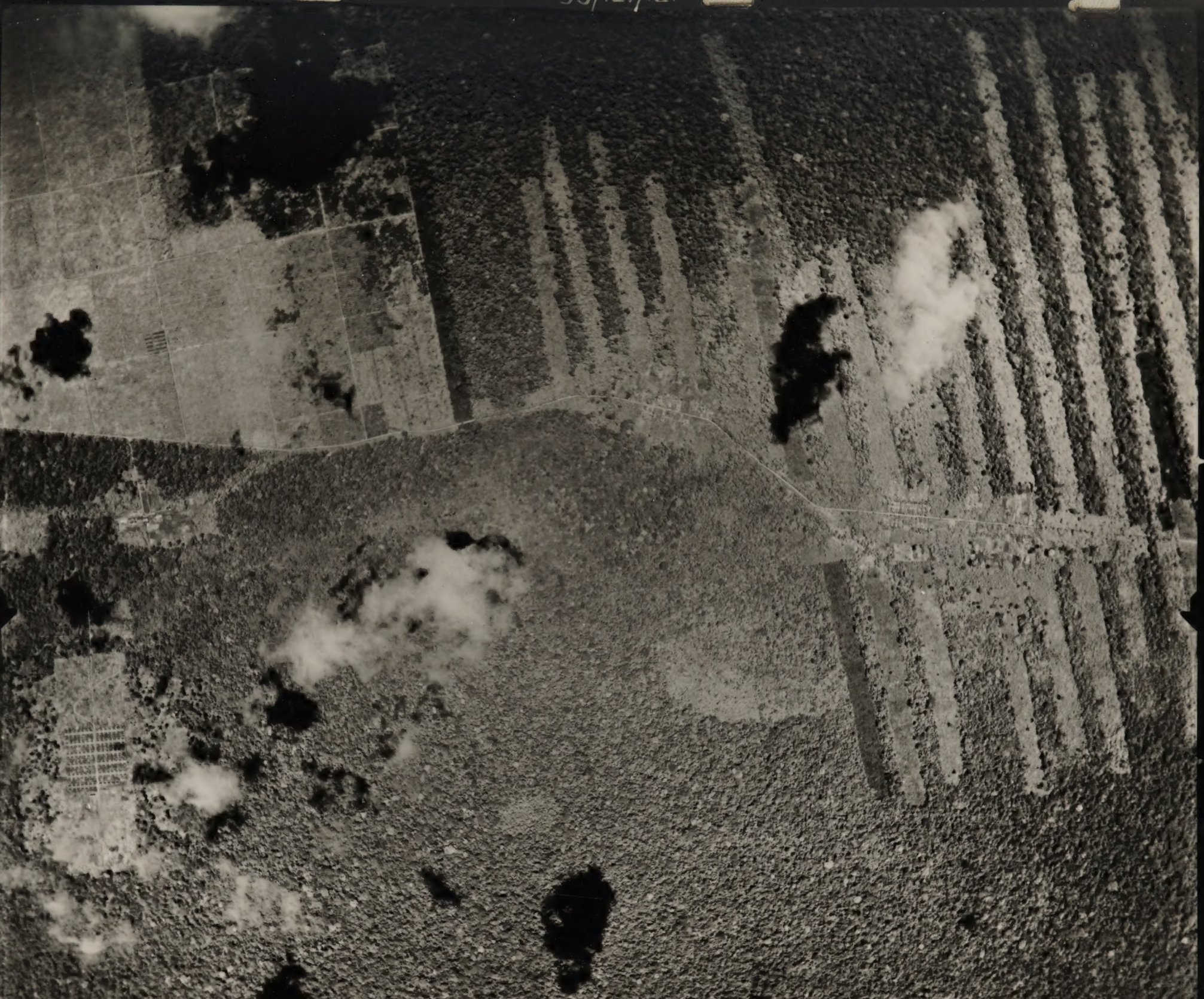
K-2300 Aug. 30, 1954. Belgian Congo. North of Yangambi. Food crop corridor in village with bananas and cassava.

K-2299 Aug. 30, 1954. Belgian Congo. North of Yangambi.
Corridor of village after nine years of forest fallow with umbrella trees - *Musanga smithii*. (Underbrush cleared away for ease of photographing).

K-2300 Aug. 30, 1954. Belgian Congo. North of Yangambi.
Food crop corridor in village with bananas and cassava.



Corridors et Yangambi



Corridors at Yangambi

X
X BARZA
X

ITINERAIRE DU PARCOURS EFFECTUE AU PAYSANNAT TURUMBU LE 30/8/54

TRIP DONE THE 30TH OF AUGUST 1954 AT THE " PAYSANNAT-TURUMBU".

ROUTE WEKO VERS YANGAMBI

OUVERTURE EN 1945

N° Couloir	N° of Corridor	
12	Ouverture en 1947 en 1948 culture mixte maïs - paddy-manioc-bananes	Open in 1947 In 1948 mixed culture maize paddy,manioc,bananas
11	FORET	FOREST
10	Ouverture en 1953 sur forêt en 1954 avant culture maïs puis paddy-bananes-manioc	Open in 1953 in forest In 1954 fore-culture of maize then paddy-bananas manioc
9	FORET	FOREST
8	Ouverture en 1946 avant culture maïs-riz-paddy manioc jachère en 1948	Open in 1946 fore-culture maize rice,paddy, manioc - fallow in 1948
7	FORET	FOREST
6	Ouverture en décembre 1944 culture mixte-maïs,bananes, paddy,manioc-jachère en 1947 à droite arachides en 1951 à gauche jachère depuis 1947	Open in december 1944 mixed culture:maize,bananas, paddy,manioc-fallow in 1947; at the right peanuts in 1951 at the left fallow from 1947
5	FORET SECONDAIRE	SECONDARY FOREST
4	Abattage en décembre 1943 en 1944 culture mixte-maïs, paddy, bananes, manioc jachère en 1946.	Forest cut down in 1943 in 1944 mixed-culture:maize, paddy, bananas, manioc fallow in 1946
3	Ouverture en décembre 1952 sur forêt. en 1953 culture mixte maïs, bananes, paddy,manioc	Open in december 1952 in forest in 1953 mixed-culture maize, bananas, paddy, manioc.
2	FORET SECONDAIRE	SECONDARY FOREST
1	Ouverture en décembre 1942 en 1943 culture mixte maïs,bananes,paddy,manioc en 1945 début de la jachère	Open in december 1942 in 1943 mixed culture maize,bananas,paddy,manioc in 1945, beginning of the fallow.

August 31:

We are up early and down to the boat for a reasonably early start up the river to Stanleyville.

This is a good time to relax a bit and talk things over with one's friends. Jurion tells me that the first research was begun at Yangambi in 1910 as a government plantation - a sort of pilot plantation. INEAC was formed in 1934 and actual research was started on African oil palm. The first research in the Low Congo was begun in 1910. They had a small laboratory and a crude soil map at that time.

On a nice wood-burning steamer we cruise slowly on this placid, lazy, Congo River under a bright and lovely sky. We arrive in Stanleyville at 4:30 p.m. and I'm taken by bus to the hotel Wagenia. Unfortunately, this hotel has no dining room, so we are taken very late in a jerky little bus to the "Pourquoi Pas" for a small dinner. I'm back at 9:30 and at once to bed.

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Elisabethville

Elisabethville

View in Elisabetbville

LIX a

top

Elisabetbville

View in Elisabetbville

LIX a

bottom

Elisabetbville

September 1

I'm up at 5:00 a.m. with a heavy pounding on the door. I had been told to be up at 5:30 so I suppose there is a change. I go down to the lobby at 5:45 and am told that I was called at 5:30! So I now have a long wait.

We are finally taken by a little bus to the Sabena Hotel for breakfast. We say goodbye to those leaving the tour here and board the plane for Elisabethville. We leave at 8:00 a.m. Near the end of the flight the plane becomes quite bumpy and some of the men have a rather uncomfortable time of it. The pilot circles a gorgeous waterfall and also a new hydroelectric dam so that all may have a good view. Probably half of the passengers would have preferred going directly to the airport. We reach Elisabethville about 3:00 p.m. I get settled in the Sabena Guest House in the edge of the city in a nice room. About 5:30 p.m. we are taken by a little bus into the city for a general reception. We return for dinner and I'm early to bed.

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September 2

I'm up a bit early to get photographs of some good examples of the large termite mounds common here. I can see from new ditches being dug that the soil is an intergrade between Yellow Latosol and Ground-Water Laterite.

At 9:00 a.m. we are taken by bus into the city for a preliminary general meeting in the local theater. It is now early spring for this area, about a month before the end of the dry season. Although some of the plants remain dormant and leafless, many are breaking their dormancy with flowers, with green leaves, or with red leaves. Especially nice are the jacarandas that line the streets and the many other beautiful flowering shrubs along the streets and in the gardens. We see many examples of flowering bougainvillea. Only a few of the gardens are irrigated.

We are given welcoming speeches in French. Jurion's is especially clear.

The gological explanation is given in French. Unfortunately I don't get it all but we will have a chance to study the texts.

Mr. C. Sys, in charge of the Soil Survey here, gives a long but very interesting discussion of the soils in the Elisabethville area. It is obvious that a great deal of hard work has been done with competence and with imagination. (See Appendix, 26) This is followed by a discussion of the vegetation.

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K-2301 Sept. 2, 1954. Belgian Congo. Near Elisabethville. Termite mound on Yellow Latosol - Ground Water Laterite intergrade. Note new small mound on top of fossil mound.

K-2302 Sept. 2, 1954. Belgian Congo. Near Elisabethville. Termite mound on Yellow Latosol - Ground Water Laterite intergrade.

K-2302 Sept. 2, 1954. Belgian Congo. Near Elisabethville.
Termite mound on Yellow Latosol - Ground Water Laterite
intergrade. Note new small mound on top of fossil mound.

I have lunch in the Sabena Guest House. Buses come and take us on a field trip. (See Appendix, 25 for guide sheet).

My first stop is to look at the Kipushi series, a Red Latosol from limestone. The dominant color is dark red (10R 3/6). The soil is well drained but nearly level and is said to have somewhat over 55 percent clay. Regular soil horizons are only weakly expressed although the surface soil is somewhat more brown than the rest and the lower part is a bit deeper red. As we look at the soil now when it is so very dry, it appears almost massive and digs out in small clods that are easily friable to fine or medium moderate granular. The B horizon is said to show fairly well developed blocky structure during the wet season when the soil is moist.

We stop again to see the Kasonte series, a Red Latosol from dolomite. From these pits in such very dry soil, the two profiles look a good deal alike. Here I notice a few vertical cracks about 15 to 20 inches apart, and a great many termite nests within the profile.

The third stop is at Kisanga Hill where we see a section from the surface down into the rock at a quarry of felspathic sandstone. Above the rock is a very interesting geological section suggesting a mud flow or slipping. I'm told that geologists are inclined to the view that this stony material is reworked glacial till of

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Cambrian age. Next we look at a shallow phase of the Misowa series, a Yellowish Red Latosol from conglomerate. I see nothing to add to the descriptions given in the guide in paragraph 5, on page 2.

We continue on and come to a fine example of Ground-Water Laterite thought to have been formed long ago in the old peneplain. The surface part is hardened but underneath there is some two meters of beautifully mottled classical soft laterite. This soil is said to be included in the Katuba series. During my previous visit to Elisabethville in 1947 (see Congo Journal) I spent the larger part of my time examining in great detail several profiles that were similar to this one.

Our last stop of the afternoon is at the Kaponda soils, said to be Yellowish-Red Latosol, developed from layered calcareous shales and showing good stone lines. (See Appendix, 25).

We are taken back to the Sabena Guest House at 6:00 p.m. I wash and change for dinner and prepare for an excursion to Jadotville. We leave the railway station at 10:00 p.m. in a beautiful new train, but a very noisy one.

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K-2303 Sept. 2, 1954. Belgian Congo. Near Elisabethville. Landscape on Red Latosol from dolomite. Kasonta series.

K-2304 Sept. 2, 1954. Belgian Congo. Near Elisabethville at Kisanga HIll. Close view deposit of reworked Cambrian till. (Brammer).

September 3

Apparently we arrived in Jadotville a little after midnight and I get a few hours sleep before an early breakfast on the train.

About 8:00 a.m. the buses come to take us on a day's tour around the city. We spend quite a little time at the large hospital maintained for the natives. The maternity sections make up a very large part of this fine looking institution. The gardens are especially nice with bougainvillea, jacaranda, and many other flowering plants.

We are taken to the museum maintained by Union Minière. In it are unusually beautiful specimens of the various minerals and crystals of minerals found in the Haut Katanga.

From there we go to the big plant that produces pure copper and cobalt by electrolytic processes. I'm told that this plant produces about 7 percent of the world's fine copper and around 70 percent of the cobalt. Most of the cobalt goes to the United States. I make no attempt to take down the many statistics we are given about this enormous plant. I notice that a great deal of the machinery is American-made and one gets the firm impression that the work is in competent hands. Nearly all the workmen are natives. Some of them are handling very delicate and important machinery.

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We are taken to lunch where we have a long wait and the lunch lasts for a long time, with all sorts of pretty speeches.

After lunch we make a rapid tour of the huge foundry and machine shop that serve the many plants and mines of Union Minière. They import their rails and machine tools but a great many of the castings and so on are made on the spot. One large section is used for melting scrap to make steel castings. Another large section of machine tools are available for nearly all kinds of heavy work as well as for fine machining of steel and other metals.

We are back to the train and head for Elisabethville about 5:45 p.m. After dinner Jurion and I have a long talk about the soil survey work in the Congo and its relationship to the other research activities of INEAC. The train gets in about 9:45 p.m. and I'm soon to bed.

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K-2305 Sept. 3, 1954. Belgian Congo. Jadotville.
Our new special train.

K-2306 Sept. 3, 1954. Belgian Congo. Jadotville.
Maternity hospital.

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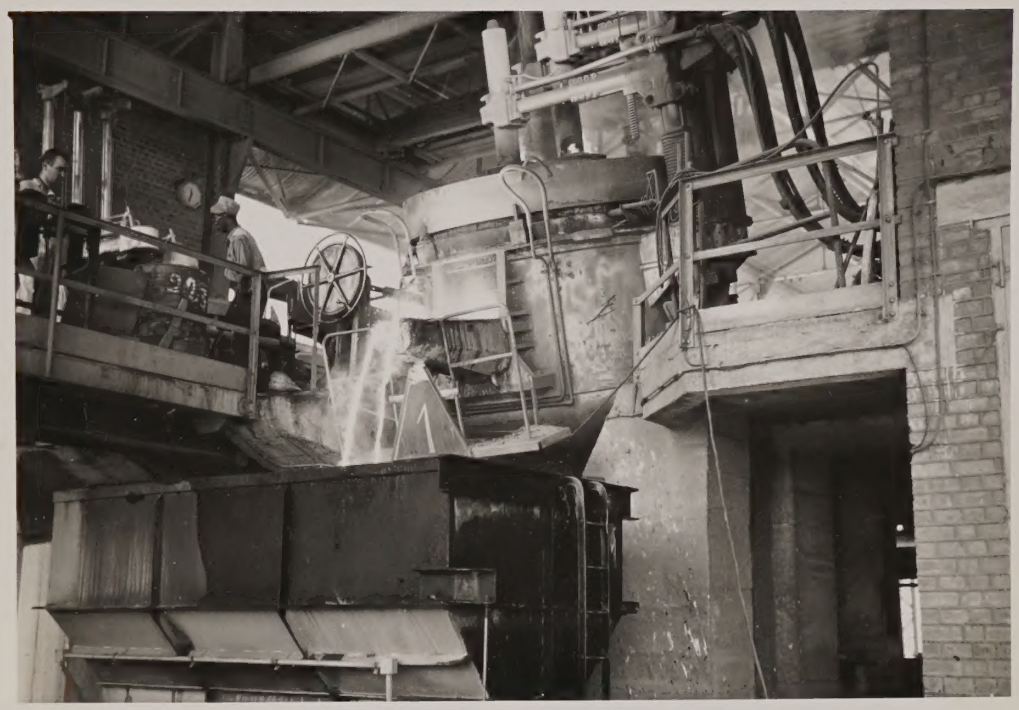
Our new special train.

K-2306 Sept. 3, 1954. Belgian Congo. Jadotville.
Maternity hospital.

K-2307 Sept. 3, 1954. Belgian Congo. Jadotville.
Partial view of smelting plant.

K-2308 Sept. 3, 1954. Belgian Congo. Jadotville.
Pouring molten copper into moulds.



K-2309 Sept. 3, 1954. Belgian Congo. Jadotville.
Tapping the cobalt furnace.

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Tapping the cobalt furnace.

September 4

We leave by bus for another tour near Elisabethville about 9:00 a.m. (See Appendix, 25 for guide sheet).

About 15 or 20 miles south of Elizabethville we take a look at the Kaponda series, a Yellowish-Red Latosol where we are supposed to notice quite a bit of difference between a soil under forest and a degraded example of the same kind of soil under savanna. The important structural differences are not so clear now as they were when the notes were prepared during the wet season.

Here I notice some cassava growing not too well because of the dryness of the soil, but well enough for a crop. The crop is managed by scraping the surface inch or half-inch of the soil into beds some 5 to 6 inches thick in order to concentrate the organic matter and plant nutrients.

In this area one cannot help being impressed by the enormous termite mounds. Probably they are fossil from an early drier period. Some of the big ones have small modern mounds on the tops.

We make a brief visit to the Keyberg station of INEAC, during which we waste a bit of time so we all may sign the visitor's book. Near the station we take a look at a Half-Bog soil (Kisanga series) that I examined in 1947 more carefully than I can now.

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K-2310 Sept. 4, 1954. Belgian Congo. 15 miles south of Elisabethville. View on Yellowish-Red Latosol (Kaponda series). Note surface soil is scraped into beds for cassava to concentrate organic matter. (C. F. Charter.

K-2311 Sept. 4, 1954. Belgian Congo. South of Elisabethvill Sys explains the genesis of the Half-Bog soil on which he stands.

We have lunch at the local golf club. At lunch Sys tells me that in some places termite-made calcium carbonate concretions amount to 5,000 kilograms per hectare or about 2½ tons per acre. He says that this may happen even on soils with laterite crusts.

After lunch Sys shows us a road cut through one of the calcium-carbonate termite mounds. Even here there is a laterite crust just beneath the general ground level. Mounds like this occur about one to three per acre, even on the Ground-Water Laterite. He thinks that these areas were poorly drained in the past and that probably the ground-water was rich in lime. He thinks the plants brought up this lime and that these plants became food for the termites.

Sys then takes us to see a series of soils of intermediate drainage from the Lupoto, a well-drained Red Latosol, to the Mutawle soil, a Gray Hydromorphic. The Lupoto has faint evidence of a structural B. Plant roots go very deeply and there are many termite nests within the soil. The parent material is likely a wind deposit originating mainly from dolomitic shale according to Sys.

As we go down the drainage scale to the Kasombo soil, a Yellow Latosol according to Sys, although I should call it a Yellowish-Red Latosol, the free iron oxide drops from 90 percent to 40 percent. The time is too short for detailed examinations. The upper soil is somewhat lighter in texture and I notice that part of the peds are considerably harder than the majority of them. Going still

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further down the drainage scale, we see the Mwita series. Sys has called this a "hydro-latosol." I explain to him that this term has been appropriated for soils in Hawaii developed under nearly continuous rainfall which have clays that dry irreversibly. I should regard this as a fossil Gray Hydromorphic. Despite the evidence of previous poor drainage, roots go to about 2 meters in depth. He then takes us down to the Mutwale series, a good example of Gray Hydromorphic with a water table around 3½ to 4 feet.

We hurry back to our hotels in order to change and go to the Leo Hotel for the final dinner of the Fifth International Congress of Soil Science. There are many stories and many pretty speeches. At 10:30 p.m. the Congress is finally finished.

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K-2312 Sept. 4, 1954. Belgian Congo. West of Elisabethville. Road cut through old termite mounds. Bottom of ruler rests on laterite crust, soil above calcareous.

K-2313 Sept. 4, 1954. Belgian Congo. Elisabethville. Termite mounds on grey soils associated with Red Latosol.

K-2312 Sept. 4, 1954. Belgian Congo. West of Elisabethville. Road cut through old termite mounds. Bottom of ruler rests on laterite crust, soil above calcareous.

K-2313 Sept. 4, 1954. Belgian Congo. Elisabethville. Terms t mounds on grey soils associated with Red Latosol.

September 5

Director-General Jurion has arranged for a special tour of the Lufira Valley. At 7:40 a.m. Tavernier, Edelmann, Stephens, Lebrun, and I leave in a small plane loaned by Union Minière. This valley lies at a considerable distance north of Elisabethville within the Katanga. A great deal of it is said to be dominated by smooth, black soils largely uninhabited. Consideration is being given to the development of this area for European settlement.

We fly first to Lac de Retenne. It is clear that the climate is getting considerably drier. We turn to the northeast toward Kisengo, then fly north over the valley and up on to the plateau beyond. The trees are defoliated about as they are around Washington in winter. The south end of the valley is swampy but in the drier places one sees some smooth soils with gilgai.

About 9:00 a.m. we land at Mitwaga. Here we are met by M. Van Oosten of the soil survey party and a driver. We go over country roads in a southwesterly direction. We start out on a plain with burned savanna and scattered trees and shrubs. On south we go up onto a somewhat higher small plateau and down again. I see only small termite mounds. Some of the soils are yellowish-red, some brown, and some red.

September 5

Director-General Jurion has arranged for a special tour of the Lufira Valley. At 7:40 a.m. Tavernier, Edelmann, Stephens, Leburn, and I leave in a small plane loaned by Union Minière. This valley lies at a considerable distance north of Elisabethville within the Katanga. A great deal of it is said to be dominated by smooth, black soils largely uninhabited. Consideration is being given to the development of this area for European settlement.

We fly first to Lac de Retenne. It is clear that the climate is getting considerably drier. We turn to the northeast toward Kisengo, then fly north over the valley and up on to the plateau beyond. The trees are defoliated about as they are around Washington in winter. The south end of the valley is swampy but in the drier places one sees some smooth soils with gilgai.

About 9:00 a.m. we land at Mitwaga. Here we are met by M. Van Oosten of the soil survey party and a driver. We go over country roads in a southwesterly direction. We start out on a plain with burned savanna and scattered trees and shrubs. On south we go up onto a somewhat higher small plateau and down again. I see only small termite mounds. Some of the soils are yellowish-red, some brown, and some red.


Kayumba
Niangu
Kyatye
2000
Lubembwe
5935
Mubidi
Mitwaba
Walebwa
Mwe
Kiusaj
5594
Musumali
Mwele
Penge
Kashimba
Kisandji
Kasingalwaya
Kalumengongo
Luange
Kasongo-Mwana
4196
Kabola
Djaniuka
Genge
6198
Kakubala
Mwepu
Kapola
Kibanda
5000
Kalaku
Kamina
Hangar Gela
Lubule
NG
Kiapulukwa
Kibambale
Kaundu
Kabenga
Kunjegu
3535
Muombe
Kimafia
5210
Kapoya
Kasolwa
Kilwezi
Kiombo
Masombwe
Mombolo
Kabenga
Muvule
Kafwimbi
Old Muvule
Kalonga
5717
Kasieke
Kalembo
5741
Kasolwa
Musafi
Mukana
4961
5813
Sakwa
Kyundu
Swana-Mutopwe
Lufira
Lombozi
Kituntuka
Kingala
Kialwe
Kadiongo
Lufukwe
Mwango
2905
Gobolole
Kapoya
5604
Musisa
Kansenia
Mwemani
Kiula
5150
KINDA
Falls
Musabira
Kongwe
Kiamanwa
Bwadi
Makonga
Mambo
Kitondo
2822
Kalanga
Kibuzi (Homme)
Munganga
Kalupanda
Kanianga
Mangala
5570
Panga Panga
Kianena
2867
Katefa
Simama
5015
PLATEAU
Kapiri
Kabemba
Mokabe Kasengu
3848
Kindi-Makumbo
Kitobo
Sambwe
Kibora
Kiungwe
Luele
Lubungwe
Kitululu
Kitenta
Luvilombo
Kalalangombe
Sandala
Musanduka
529
Museba
Kamfwa
Katetelwa
2874
Sumpwa
8°W
5313
Luswaka
3025
Mukuto
4694
Sonkolo
Kibuzi (Femme)
Mijambo-Kabobo
5570
Mokabe Kasari
Mwalimbado
Kiamakosa
Pemba-Moto
NF
Mukenge
Dikusu
Kimungu
Kikeba
DES
3212
Kalwa
Kitanda
4418
20
30
40
50
Kapungwe
2884
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Lupembe
Kongolo
Kisamba
Dikuluwe
Kubantu
2867
Kapungwe
Kabundi
Kiaba
Mumpepe
Mabala
50
Lualala
Mukebo
5635
Buleya
KUNDELUNGU
5000
Lumbanya
Kasangula
Kasongonona
Lofoi
Ngwa
Tondo
Mwenemena
5045
Mukabole
Kanikile
Kalumba
Wawaya
Loami-Ninga
Mirambo
Bunkeya
Kibanda
Musomoka
Samba
Kabunda
Camp Kiswaila
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Mpashi
4905
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Sunta
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4116
Kaboto
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Mulenga
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Lufira
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Lupashia
Mwashya
Mukulukushia
Muyuya
5271
Tambo
Matafu
Sogefor Power Plant
Kasangula
Kafila
4776
Gombela
Dikuluwe
4060
4823
469
Kalumkumia
Kigongo
Kimbwi
Kamboye
Kisunka
10
Mafinge
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Kieka
4334
Mwelwa
Lac de Retenue
Katete
Kisanga
Kimengwa
Mukabi
Jadotville
NE
Luale
Kangulu
Mulemwa
Panda
Mulangi
3872
Kalemba
Kiabora
Lufira
Tshibangulwa
Makaka
Mutipul
Kasawenda
Tanga
Katanga
Mushinge
Kalase
5628
Kiwongo
Kipopo
Minga
Kashimbo
4994
station
4225
Lubombo
Kamongo
Wiswila
Kashioba
Jila-Simba
4406
Malambwe
Kifita
Mutumbe
4621
Lupoto
Mwati
Kikalwe
Sofumwango
5184
Galu
Wabaya
Sofumwango
Jila-Tembo
Sompwe
Tenke
40
Masari
Kakungu
Kinke
Mututa
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Kiabora
Kibuye
Klawawira
Kiambe
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Luiswishi
Musonge
Kaliongo
Dikansa
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Sakuya
Shindaika
Djibu
Kandakana
Mukupa
Tanganika
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ELISABETHVILLE
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Airport of Entry
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Bombwe
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Katuta
Kalufie
Kambove
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Kafue River
Muganga
Djidjeke
Muniama
Shimpeni
Mutwale
Mushindamu
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Tutwe
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Kunkuba
Lusungo
Baya
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Kiema
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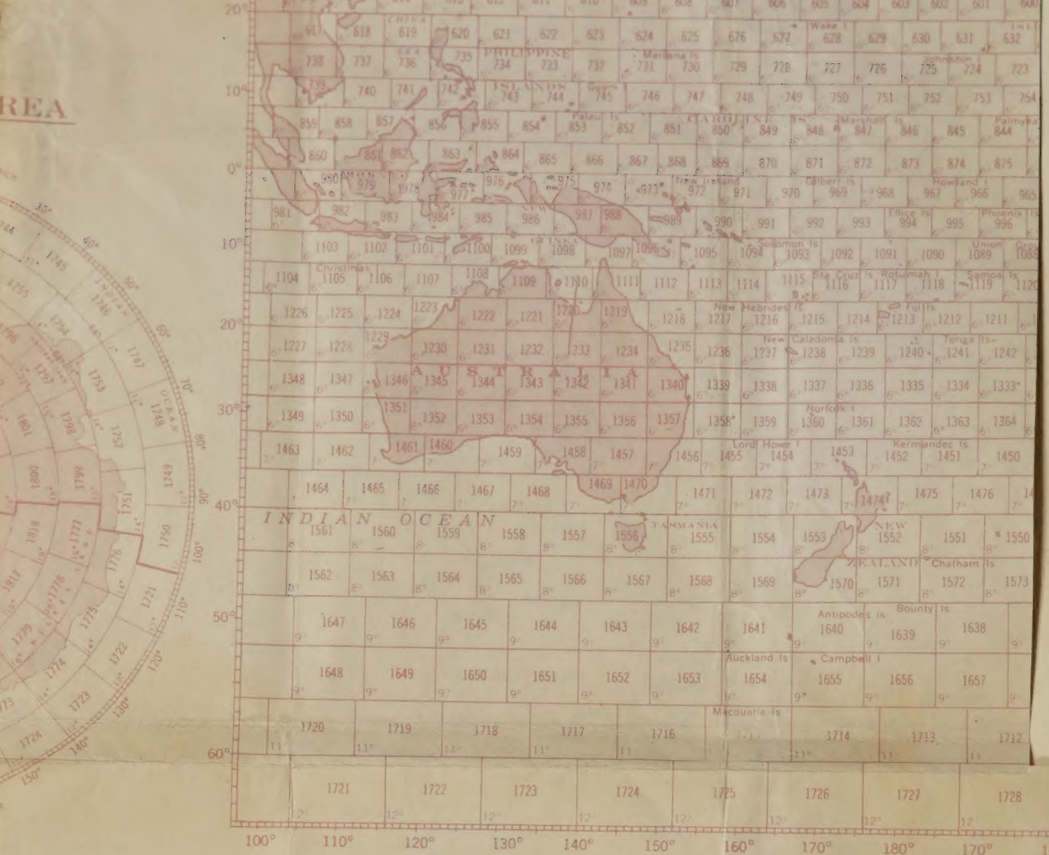
4508
Katonga
Makensa
RHODESIA
GREAT BRITAIN
ND
Mwampa



WORLD AERONAUT

Scale of Seri

UTICAL SYMBOLS

ERODROMES

AIRFIELDS — LIMITED FACILITIES Refueling services for normal traffic and limited repair facilities.

SEAPLANE LANDPLANE

Military

Civil

Joint Civil and Military

OUNDS and ANCHORAGES

ith Landing Strip — Very limited or no facilities or complete information not available

Very limited or no facilities or complete information not available

ted or no facilities

FIELD DATA

, boundary or runway lights, wind indicator

ly all-weather

rea

nearest hundred feet

rfield data is lacking, replaced by a dash (-).

SKYVIEW 300 LH 60

TARANTO 3 LS 99

ASANSOL 300 -H 60

TARANTO 3 -- 99

VIGATION LIGHTS

ndicate elevation above mean sea level.

Flashing Light (With code)

Obstruction Light

Marine Light (Elevations of marine lights are above high water) Occ W R G 9.2

Lightship

Occulting Alternating

Gp—Group B—Red W—White G—Green B—Blue (U)—Unwatched SEC—Sector sec—Second

l; alternating lights are red and white unless otherwise indicated.

CELLANEOUS

AERONAUTIC

RADIO F

All frequencies are kilocye

Methods of indicating specific vo

Radio Range (With voice) — WOODY RADIO 291 AB

Radio Range (Without voice) — WILLOW RANGE 320 KB

Non-Directional Radio Beacon (With voice) — R Bn EVERETT BEACON 224 MMC

Non-Directional Radio Beacon (Without voice) — R Bn EVERETT 224 MMC

Marine Radio Beacon — M R Bn ISLAND 309 BO

Radio Direction Finder (With voice) — DF MANUA HOMER 116.1 mc

Radio Direction Finder (Without voice) — DF MANUA 4595 VFPW

AIRCRAFT LANDING FACILITY INFORMATION

RAMEY AFB
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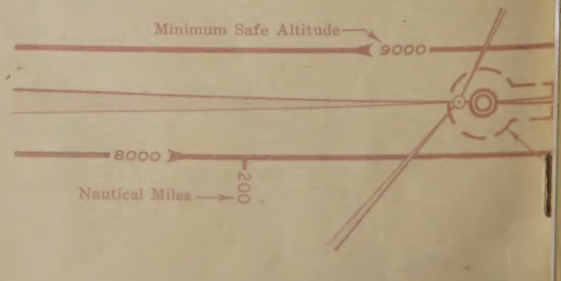
Airport of Entry
ILS GCA
RAMEY TOWER
278 116.1 mc

AIRWAYS & RADI



AIRSPACE RÉS

Dr Kellogg

EXCURSION GUIDE TO THE LUFIRA VALLEY

1. General informations about the Lufira valley.

ography

It is supposed that in the middle of the pleistocene period a part of the old peneplain which still exists on the plateaus of the Kundelungu and Biano Mountains sunk and formed a rift valley. It is further supposed that the lower parts of this sunken peneplain were filled by a lake which formed lacustrine deposits. Later, through the Kiubo-falls, this lake was drained and the Lufira river made its way into the plain.

The two distinct parts within the rift valley can easely be recognized on the soil map : first the remnants of the old peneplain and secondly the younger lacustrine and alluvial formations.

ogy

The soils of the old peneplain are mostly derived from fine grained shales and limestones, which belong to the upper series of the Kundelungu-system of Katanga.

nt rial on- vial s.

Only in a very few locations, these rocks can be considered to be the parent material of the soils we meet in the peneplain. Mostly the soils developed on

1. gravels formed by the desintegration of the shales.
2. aeolian (?), colluvial or older alluvial deposits which form a thin cover (1,5 - 2 m.) upon the rock. Those soils are not considered as weathered porducts of the rocks themselves because we found almost always immediately or slightly above the rock a layer of quartz or laterite gravel with many perfectly rolled stones, showing thus an unconformity.
3. Only in a very few cases we observed actual weathering of limestone into autochtonous soil profiles.

s of the plain.

The first parent material, the shale gravel, is in most cases cemented into a hard ironcrust. Undoubtedly there are several, perhaps three levels of deposition, cimentation, redeposition and recimentation of the crust in the topography.

The colluvia or alluvia we observed in the area of the penepl plain developed into LATOSOLS. Those resting on limestones are red whereas the colour of the soils lying on the shales is markedly changing with drainage. On well drained sites the colour is brown red (5YR till 2.5YR); the lesser the drainage, the lighter become the colours and the soils may develop into hydro-latosols.

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Soils of the peneplain.

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A special soils formation on a thick,hard,cavernous calcareous material,a real caliche or hardpan which is supposed to have been formed in a dry period in the pleistocene (probably post gamblian arid phase).On this caliche a sometimes thick,but most of the time thin layer of dark,black soil has developed similar to the black Rendzinas of Europe,but without the gradual transition from rock to soil and a low organic carbon content.

Alluvial soils topography. The rivers which cross the valley,the L'ufira and the Dikuluwe built up a system of levées and basins,probably within the existing lacustrine deposits.These rivers have been displacing their streambeds perpetuously and ols levées and basins are resulting.

Parent material. alluvia Several textural profils may be found in the alluvial flat : heavy clays,loams,clay on sand,sand on clay ; the most frequent are nevertheless heavy clays and levées which are loamy.

Subdivision of alluvial soils. The subdivision of the heavy clay soils is made first of all upon the presence or absence of gilgai microrelief.The gilgai soils seem to have a typical distribution in the plain,mostly on the highest,horizontal surfaces with practically no slope.As soon as a slope appears the gilgai soils are replaced by flat poorly drained and very poorly drained soils.The first show a very strong mottling just beneath the A_1 horizon ; the second have a very thin muck layer resting on the mineral soil and are defined to small depressions.

Gilgai soils The subdivision of the gilgai soils is made according to the colour and the amount of gypsum in the profile.Almost all of them have a C_{cs} above a C_{ca} horizon.The main subdivisions in this group of gilgai soils are :

1. Brown gilgai soils with mostly little gypsum.(IO YR)
2. 2.5 YR gilgai soil with much gypsum.
3. Gray gilgai soils with usually much gypsum. (4/o ; 3/0 to 2.5 y 4/1)

The changes in colour of this soils may be due to the origin of the alluvial deposits or to the drainage class.The brown soils have a better drainage than the two other ones.

Levée soils The soils of the levées have a sandy loam texture and show very little horizon differentiation in the profile.They are subdivided into old and recent levées which are recognizable by a gypsum accumulation in the old levée soils.They are,accordingly to their situation close to the rivers and their lighter texture,mostly occupied by the natives.

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Alluvial soils geography.

The rivers which cross the valley,the I. Rida and the Dikulwe built up a system of levees and beams,probably within the existing lacustrine deposits.These rivers have been diagging their streambeds perpetuously and old levees and beams are resulting.

Present Alluvial. Alluvia

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Levee soils

The soils of the levees have a sandy loam texture and show very little horizon differentiation in the profile.They are subdivided into old and recent levees which are recognizable by a gypsum accumulation in the old levee soils.They are,accordingly to their situation close to the rivers and their lighter texture,mostly occupied by the natives.

Legend

			Excursion point
1. Zone of the old peneplain			
1.1 On shale-gravel			
	111.1	with hard ironcrust	5
1.2 On aeolian(?),colluvial deposits.			
	12.1	resting on shales	
		121.1 poorly drained	6
		121.3 well-drained	4
	12.2	resting on limestones	
		122.1 well drained	
1.3 derived from rocks			
	13.1	from limestones	
	13.2	from caliche	1
2. Zone of the recent alluvium.			
2.1 On heavy clays			
	21.1	with GILGAI microrelief.	
		211.1 brown,mostly little gypsum	2
		211.2 2.5 Y;much gypsum	7
		211.3 gray;much gypsum	10
	21.2	without GILGAI microrelief	
		212.1 poorly drained	11
		212.3 very poorly drained	8
2.5 On levées			
	25.1	251.1 recent levée-soils without gypsum	3
		251.2 old levée-soils with gypsum	9

	Excursion point
1. Zone of the old peneplain	
1.1 On shale-gravel	
111.1 with hard ironstone	5
1.2 On scolitan(?).colluvial deposits.	
12.1 resting on shales	
121.1 poorly drained	6
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13.2 from salions	
2. Zone of the recent alluvium.	
2.1 On heavy clays	
21.1 with OLIGAI microrelief.	
211.1 brown,mostly little Gypsum	2
211.2 2.5 %;much Gypsum	7
211.3 Gray;much Gypsum	10
21.2 without OLIGAI microrelief	
212.1 poorly drained	11
212.3 very poorly drained	8
2.3 On levees	
23.1 231.1 recent levee-soils without Gypsum	3
231.2 old levee-soils with Gypsum	9

3 . Pregram

SUNDAY , 5th september 1954.

	12.00 h.	Dinner
	13.30	Introductory lecture
	14.00	Kiubo - Sambwe kibora
POINT	1	Visit of ancient caliche (13.2)
	2	Brown gilgai soil (211.2
	3	recent levée soil (251.1)
	4	well drained soil on shales (121.3)
	5	iron crust on shales (111.1)
	6	poorly drained soil on shales (121.1)
	18.00	Arrival at Kiubo
	19.30	supper.

MONDAY , 6th september 1954

	6.30	Breakfast
	7.30	Excursion on the Lufira
Point	7	Visit of 2.5 Y Gilgai soils (211.2)
	8	very poorly drained alluvial clay soils(212.3)
	9	ancient levée soil (251.2)
	10	Gray Gilgai soil (211.3)
	11	poorly drained alluvial clay soil (212.1)
	12.00 h	Lunch
	13.00 h	Kiubo-Mitwaba
	15.45	Mitwaba- Elisabethville.

3 . Programme

SUNDAY , 3th September 1954.

12.00 h. Dinner

13.30 Introductory lecture

14.00 Kiubo - Bambwe Kibora

POINT 1 Visit of ancient oaliche (15.2)
2 Brown gilgai soil (211.2
3 recent lavée soil (231.1)
4 well drained soil on shales (121.3)
5 iron crust on shales (111.1)
6 poorly drained soil on shales (121.1)

18.00 Arrival at Kiubo

19.30 supper.

MONDAY , 4th September 1954.

7.30 Excursion on the Luvira

Point 7 Visit of 2.5 Y Gilgai soils (21.2)
8 very poorly drained alluvial clay soils(212.3)
9 ancient lavée soil (21.2)
10 Grey Gilgai soil (21.3)
11 poorly drained alluvial clay soil (212.1)

12.00 h Lunch
13.00 h Kiubo-Mitwaba

15.45 Mitwaba- Kitambabwilla.

SEP 14 1954

1-

AIRPOUCH PRIORITY

UNCLASSIFIED
(Security Classification)

DO NOT TYPE IN THIS SPACE
399.7322-LE/9-454

FOREIGN SERVICE DESPATCH

SCS
C E Kellogg

FROM : AMCONGEN, Leopoldville, Belgian Congo. DESP. NO. 91

TO : THE DEPARTMENT OF STATE, WASHINGTON. DATE September 4, 1954

REF : Dept's CA-904, August 6, 1954 and previous.

For Dept. Use Only	ACTION	DEPT.
	OIC-* 1	REP-2 OC/R-2 OLI*-6 EUR-5 NEA-4 E-4 U/SA*-1 IO-4
	REC'D 9/10	INFO OTHER AG*-6 CIA-5

SUBJECT: Fifth International Congress of Soil Science held at Leopoldville.

The Fifth International Congress of Soil Science opened at Leopoldville on August 16 and closed its meetings on August 21. The formal meetings were followed by excursions to the Bas-Congo and to the main Belgian Congo agricultural research station at Yangambi (Oriental Province), ~~in~~ which most of the delegates participated.

The Congress was attended by over 200 delegates, including 13 representatives from the United States. The list of the United States representatives given in Leopoldville D-17, July 3, 1954, is correct except for the names of Messrs. Lathrop and Page, who were unable to attend. One copy of the official list of delegates is attached.

A number of papers were presented by the American participants, two of them ("Soil Conservation" by Dr. Kellogg of the United States Department of Agriculture, and "Soil Structure" by Professor Bradfield of Cornell University) before the Congress as a whole. A complete list of all papers presented at the conference, as well as the Conference agenda, and lists of the members of the General, Patronage, Organizing and other committees, is given in the Programme of the Session of which four copies are attached.

The Congress took place without incident so far as the Consulate General was concerned. It is reported by the United States visitors to have been most successful, from a technical as well as from an organizational point of view. It is understood that Dr. Kellogg, as unofficial dean of the American group, will submit a report for his Department on the more important technical aspects of the Congress.

The Principal Officer received the United States participants in the Congress at an informal reception on August 20, at which the senior representatives of the Institut National pour l'Etude de l'Agronomie au Congo Belge (INEAC) and of the Department of Agriculture of the Colonial Government were also present.

Robert G. McGregor,
American Consul

Enclosure: 4 copies Programme
1 copy list of delegates

cc: Brussels

RLYOST/KV REPORTER

UNCLASSIFIED
INFORMATION COPY

We drop down into a small stream valley with yellow soils on the slopes and pass on to a plain of yellow soil of medium texture except for clay soils in the lowest parts that show evidences of gley.

At about 15 miles we bear west towards Kiubo. We travel over a gently undulating plain of yellow soil. I am amazed how the young trees are now putting out some leaves with the soil so dry. This is probably a very old plateau with laterite underneath. At about 30 miles we come out into a broad valley of Red Latosols with very few termite mounds. We pass areas of stony soil. The stones appear to be schists and may be the country rock. As we go on, the land becomes still drier. Fewer of the trees have green leaves. Along here I see an upturned tree with lateritic boulders clinging to the roots. Probably the laterite layer cracked and tree roots went through it. This may explain the piles of lateritic boulders one often sees on post-mature Ground-Water Laterite soils.

Apparently our local guide, Van Oosten, has been wool-gathering and we have missed a turn. This means several extra miles of this rough road along the margin of the valley, and that we shall be late for our meeting.

We come to the Hotel des Chutes at Kiubo about 12:30 p.m. The little hotel is built just on the margin of the beautiful Kiubo Falls. Here we find d'Hoore, Laudelout, Dudal, and Van Wambeke. We have lunch and start for the field at 2:00 p.m. (See typed guide sheet inserted.)

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K-2314 Sept. 5, 1954. Belgian Congo. Kiubo Falls.

K-2315 Sept. 5, 1954. Belgian Congo. Near Kiubo.
Profile of Rendzina-Mamba series.

Our first stop is at the Mamba series, a Rendzina from fossil croûte calcaire. The dark surface soil is thin. The soil is gently undulating. Below the black surface the parent material is streaked with gray and yellow. This partly weathered material digs out in small, irregular chunks. Certainly pasture is the best use for this soil.

As we drive on the micro-relief is more pronounced. We pass over a large plain of old Ground-Water Laterite soil. The surface soil is thin and in places nonexistent. Where there is enough soil for trees one can see the rings of lateritic boulders on the surface forced up or pulled up (as above) by the growth of the large trees. Where big roots develop just under the cracked laterite, boulders are thrust to the surface during the life of a single large tree before it falls. (See Down-Under Journal, Vol. 1)

We stop to look at the Simama series spoken of locally as a "brown gilgai." It belongs in the general group of Tropical Black Clay. The surface is nearly flat. There is a faint development of broad micro-relief. The cover is nearly head-high grass with only a few trees. I look at the soil in the higher part of the swells:

A_1	0-2"	Black (5/3) clay. The soil digs out in clods of low bulk density that are friable with difficulty. Many roots.
A_{31}	2-8"	Mottled dark brown and dark grayish-brown, heavy clay with coarse blocky structure that falls into medium blocky.

Our first stop is at the Mamba series, a Rendzina from fossil crouûte calcaire. The dark surface soil is thin. The soil is gently undulating. Below the black surface the parent material is streaked with gray and yellow. This partly weathered material digs out in small, irregular chunks. Certainly pasture is the best use for this soil.

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A_1	0-2"	Black (5\3) clay. The soil digs out in clods of low bulk density that are friable with difficulty. Many roots.
A_{31}	2-8"	Mottled dark brown and dark grayish-brown, heavy clay with coarse blocky structure that falls into medium blocky.

A_{32}	8-30"	Mottled yellowish-brown and dark yellowish-brown clay with well developed coarse blocky structure that falls easily into medium angular blocky. Some rounded concretions. Transitional. Diffuse boundaries.
C	30-55"+	Yellowish brown (10YR 5/6) heavy clay with coarse angular blocky structure. In places the soil is roughly prismatic. The coarse blocks break with difficulty to smaller ones. In depth the material becomes more nearly massive and one finds many small crystals of gypsum. In the upper part of the C the blocks have slick faces.

In the slightly lower places between the mounds, the black color carries down to about 24 inches and the A_{31} goes to around 36 inches. This soil is said to have about 18 inches of water standing on it for nearly two months in the rainy season. The low mounds, which are about 50 to 100 feet apart, are only about 8 to 10 inches higher than the intervening swales.

We drive on through a village near the river and walk over to the river along which is a dark brown silty clay Alluvial soil developed on the natural levee. This soil has rather dense savanna along with a few trees. It is not flooded in the rainy season. Besides being abundant in the surface soil, plant roots go deeply. The soil digs out in large irregular clods and are very dark grayish-brown. (10YR 3 5/2) There is little definite profile

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K-2316 Sept. 5, 1954. Belgian Congo. Lufira Valley. Landscape of Simama series. A brownish Black Tropical Clay with mild gilgai.

K-2317 Sept. 5, 1954. Belgian Congo. In Sambwe Kibora in Lufira Valley. Group of natives on edge of river.

development except for the dark grayish-brown surface soil, which gradually gives way in depth to reddish-brown (5YR 5/4). Below about 40 inches I see some lateritic particles. This material beneath has a very poor blocky structure with vertical cracks 12 to 30 inches apart, which fade out at about 60 inches. In the upper part of this parent material the soil is vesicular. All of it is friable with difficulty.

We return through the village, Sambwe Kibora, and look hastily at a well-drained reddish-brown soil from shale material included in the Kapiri series. This is a Red Latosol on a plain:

A_1	0-2"	Dark reddish-brown (5YR 3/2) clay with irregular, hard medium blocky structure.
A_2	2-8"$\pm$2"	Yellowish-red (5YR 4/6) clay having a hard angular medium to coarse blocky structure with irregular reddish-brown coatings on the aggregates. This grades through a diffused boundary to:
B_2	8-36"	Red (2.5YR 5/8) clay with irregular coarse blocky structure that is fairly easy friable. The soil has some vertical cracks at intervals of 6 to 12 inches that go to 72 inches. There are many roots and some termite nests. The soil grades into:
C	36"+	Similar material to the B but with slightly less well developed structure.

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A_1	0-2"	Dark reddish-brown (5YR 3/2) clay with irregular, hard medium blocky structure.
A_3	2-8"±2"	Yellowish-red (5YR 4/6) clay having a hard angular medium to coarse blocky structure with irregular reddish-brown coatings on the aggregates. This grades through a diffused boundary to:
B_2	8-36"	Red (2.5YR 5/8) clay with irregular coarse blocky structure that is fairly easy friable. The soil has some vertical cracks at intervals of 6 to 12 inches that go to 72 inches. There are many roots and some termite nests. The soil grades into:
C	36"+	Similar material to the B but with slightly less well developed structure.

K-2318 Sept. 5, 1954. Belgian Congo. In Sambwe Kibora in Lufira Valley. Beer is made from maize and river water placed in jugs surrounded by a brush fence.

K-2319 Sept. 5, 1954. Belgian Congo. In Lufira Valley. Landscape of Kapiri soil - a friable Red Latosol from shale. I think very low phosphorus accounts for the slow recovery of the vegetation.

K-2318 Sept. 5, 1954. Belgian Congo. In Sankuru Kibora in Lufira Valley. Beer is made from maize and river water placed in jugs surrounded by a brush fence.

K-2319 Sept. 5, 1954. Belgian Congo. In Lufira Valley. Landscape of Kapiri soil - a friable Red Latosol from shale. I think very low phosphorus accounts for the slow recovery of the vegetation.

This plain is probably a fairly recent alluvial fan of some kind. The soil has not been subject to a great deal of change since the formation of the plain except for the development of the A_1 and the weakly structured B. There has been a hot savanna fire here and the vegetation is quite thin and sparse. One sees a good deal of bare soil between plants that is subject to local wash and to blowing. Some say that this vegetation indicates a poor soil. One can point to the fact that crowns of some of the plants are a little above ground level and this suggests erosion. Yet I am convinced that such erosion is almost wholly local and probably is accentuated by the blowing away of the thin granular mulch that likely forms each year.

With the data at hand I can only speculate but I believe this to be a good example of where one can be misled about soil productivity by overemphasis on the condition of the wild vegetation. I suspect this soil to be very low in phosphorus and that this deficiency is responsible for the weak vegetation following fires and other accidents. For agriculture I suspect that this soil is actually considerably more productive than the Tropical Black Clays if supplied with phosphorus.

We return to the hotel for a late dinner. It seems a pity that we need to use keorsene lanterns rather than electric lights on the margin of this enormous waterfall.

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September 6

The roar of the waterfall awakens me about 5:00 a.m. Since I have no way to turn it off I might as well get up and dress. We gather for coffee and hope to get an early start. We leave at 7:25 a.m.

We first stop to look at a rather grayish member of the Tropical Black Clay. Here the soil has fairly well developed gilgai with about 8 to 12 inches of relief and mounds 15 to 25 feet apart. I should call this mild gilgai. The soil has a dense covering of grass about shoulder high. I first look at the soil between the mounds:

A_{11}	0-2"	Black clayey soil of low bulk density that is easily friable to very fine granular. The soil is mixed with a heavy brown root mat. The lower boundary is diffuse.
A_{12}	2-9"	Black coarsely prismatic hard clay. The structural units are separated by cracks of 1/16 inch to 1/2 inch. These peds have some dark brown shading on the margins.
B_{2g}	9-30"	Black, coarsely prismatic hard clay. Roots penetrate the material. There are some small gypsum crystals in the lower part.
B_{3g}	30-44"	Very dark grayish brown (2.5YR 3/2) plastic clay, mottled slightly with shades. Massive to coarsely prismatic.
C	44-60"+	Grayish brown (2.5Y 5/2) plastic clay, mottled faintly with shades.

The salt efflorescence is probably magnesium sulphate. This occurs on the dry sides of the pit below 30 inches. At the margins of the pit the roughly vertical dry blocks have lower boundaries of slick planes at about 45° angles.

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The salt efflorescence is probably magnesium sulphate. This occurs on the dry sides of the pit below 30 inches. At the margins of the pit the roughly vertical dry blocks have lower boundaries of slick planes at about 45° angles.

K-2320 Sept. 6, 1954. Belgian Congo. Lufira Valley. View of Black Tropical Clay with shoulder-high savanna. Mild gilgai. The pick is in the low place. Relief is about 8 inches.

K-2321 Sept. 6, 1954. Belgian Congo. Lufira Valley. Discussion at profile of Black Tropical Clay. (L TO R) Van Oosten, Lebrun, TAVERNIER.

K-2320 Sept. 6, 1954. Belgian Congo. Lufira Valley. Wall of Black Tropical Clay with boulder-high savanna. Mafa Bilgai. The pick is in the low place. Relief is about 6 inches.

K-2321 Sept. 6, 1954. Belgian Congo. Lufira Valley. Discussion at profile of Black Tropical Clay. (L TO R) Van Oosten, Lebrun, TAVERNIER.

I look at a pit made in the higher place. Here the upper boundary of the B_{3g} comes at 18 inches. Here too, now that the soil near the margins is dry, the large prisms break out very easily along slickened planes with 45° angles.

From the appearance of the soil and the preliminary laboratory data available, it is clear that this Tropical Black Clay is not only high in magnesium and low in organic matter, but also high enough in exchangeable sodium to place it in an intergrade toward Solonetz. I try for pictures here in this dense grass. (K2320) As I walk through this grass which is so dense and dry, I marvel that it has not burned.

Near the margin of this low area I look at a soil in which the black surface gives way gradually to a reddish-brown clay instead of grayish-brown at about 12 to 18 inches. Below this depth the soil is slightly mottled; and this mottling increases until below 40 inches the mass is well mottled with medium-sized mottles that are yellow and yellowish-red. Also in this soil there seems to be some gypsum and some magnesium sulphate below 24 inches. Apparently this soil is developed from old red alluvium and I should regard it as a Tropical Black Clay grading only slightly toward a Red Latosol. There are also faint suggestions of solodization. The soil is very heavy and very hard when dry, but not quite so extreme as the previous one. There is little or no gilgai. The preliminary data show less magnesium sulphate here. The upper soil has a pH of 5.5 and that at about 18 inches a pH of 7.7.

I look at a pit made in the higher place. Here the upper boundary of the B_{2g} comes at 18 inches. Here too, now that the soil near the margins is dry, the large prisms break out very easily along slickened planes with 45° angles.

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K-2322 Sept. 6, 1954. Belgian Congo. Lufira Valley. Savanna on Black Tropical Clay with gilgai.

K-2323 Sept. 6, 1954. Belgian Congo. Lufira Valley. In native village on bank.

K-2322 Sept. 6, 1954. Belgian Congo. Lufira Valley.
Savanna on Black Tropical Clay with gilgai.

K-2323 Sept. 6, 1954. Belgian Congo. Lufira Valley.
Native village on bank.

In the lower soil below 15 inches the data show 5 milliequivalents of exchangeable sodium, which amounts to about 20 percent of the total exchangeable bases. These data suggest that this soil also is tending toward a Solonetz.

I walk back to the road and on down toward the river. Near the bank I try for pictures of native-grown sugarcane and maize (now harvested) grown in raised beds on the brown soil of the levee.

Here on the river bank we go into a boat in order to look at some kinds of soil not accessible by road. There is an interesting succession of plants along the river, starting near the water with tall grass-like reeds that lean toward the center of the stream. These are backed by large papyrus. Then directly along the margin of the river are trees. Beyond these are the great areas of almost solid, tall savanna. At a mile and one-half or so down the river we land and walk back from the stream some distance to see another Tropical Black Clay with bad drainage. There is a dense grass cover some 40 inches high. The soil has mild gilgai with relief of 10 inches and mounds about 30 feet apart. This soil is said to be in the Kibora series. I look at it in a low place where it is very much like the first one seen in the morning but with even more intense cracking into very hard, coarse, black prisms.

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K-2324 Sept. 6, 1954. Belgian Congo. View on Lufira.

K-2325 Sept. 6, 1954. Belgian Congo. Along the Lufira. Pelican-like birds on "sausage"tree.

A_{11}	0-1"	Brownish-black soil with many roots. The soil has low bulk density and a mixed medium cloddy and fine granular structure. This grades into:
A_{12}	1 1/2-31"	Black clay with coarse, hard prismatic peds that break with great difficulty to coarse angular blocks. In all of this soil much of the breakage of the prisms is along planes at 45° angles. Roots are relatively abundant.
C_{cs1}	31-43"	Hard, massive clay mixed with gypsum and moderately mottled with gray and yellowish brown. Only a few vertical cracks.
C_{cs2}	43-50"+	Like the above but moist and heavily charged with crystals of gypsum.

On the higher part, the surface soil is like that just described. The A_{12} is a dark gray (2.5/0) clay going to about 12 inches. This is underlain by an A_{3g} with a lower boundary at about 28 inches. The soil is dark olive gray clay with gray mottles from the gypsum and black streaks along the cracks. The soil is coarsely prismatic with breakage planes at 45°. Both upper and lower boundaries are very diffuse. The C_{cs1} is gray massive clay mottled with olive brown and light gray. The soil contains abundant gypsum. The sides of the cracks are slick but the cracks are few. At 46 inches I find the C_{cs2} as I had found it in the other profile. The soil is moist and very heavily charged with gypsum. It may be a bit darker and is mottled with gray and yellowish brown.

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This soil is said to be flooded only occasionally for 4 to 6 weeks. I suspect that this gypsum is fossil and was probably laid down during the previous geological period when this part of the valley was a lake. The gypsum remains because it has no place to go. I should regard this soil as a Tropical Black Clay intergrading to an interior Solonchak.

We walk over to another profile a little nearer the river and having better drainage. This is not significantly different from the second one we saw this morning except that this one has an olive gray A_{12} with reddish-brown soil beneath.

We then move on to look at a poorly drained Tropical Black Clay having only faint gilgai. At least superficially, the soil appears to be much like the first profile we looked at after leaving the boat except that there is little or no gypsum or calcium carbonate in the lower soil, which is reddish-brown here. This profile has developed in an old waterway or crevasse channel back of the natural levee. The soil here is said to be flooded for a few weeks near the end of each rainy season. It has a tough two-inch surface root mat. The A_{12} lies between 2 to 7 inches. In color the soil is between a very dark brown and a very dark olive brown. The soil has some mottles and is streaked with fine brown veins. The A_{13} goes to about 45 inches and consists of black, coarsely angular blocky clay, which grades into the C, a reddish-brown plastic clay mottled with yellowish-brown. Now it is moist and massive.

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K-2326 Sept. 6, 1954. Belgian Congo. Near the Lufira. A view of Kibora series - Tropical Black Clay with gilgai intergrading to interior calcium sulphate Solonchak.

K-2327 Sept. 6, 1954. Belgian Congo. Lufira Valley. Tavernier standing on Tropical Black Clay - Alluvial intergrade. Grasses: foreground, Setaria ancepts: background: Vetiveria zizanoides tall sort, Sesbania (sp) - a legume.

K-2326 Sept. 6, 1954. Belgian Congo. Near the Lufira.
View of Kibora series - Tropical Black Clay with gilgai
intergrading to interior calcium sulphate Solonchak.

K-2327 Sept. 6, 1954. Belgian Congo. Lufira Valley.
Traverser standing on Tropical Black Clay - Alluvial
interfrade. Grasses: foreground, Setaria anceps:
background: Vetiveria nigrenolens tall sort, Sesbania (sp) -
a legume.

K-2328 Sept. 6, 1954. Belgian Congo
On the Lufira.

Time is running out and we take the boat back for a couple of miles where we have the cars and reach the hotel at 11:40 a.m.

These so-called "gilgai" soils seen today all belong to the general group of Tropical Black Clay, with intergrades to (1) Alluvial, (2) interior calcium-sulphate Solonchak, (3) weak Soloth, and (4) weak Solonetz. The gilgai is an added feature, important but not strongly developed, and not a differentiating characteristic above the soil series level. The soils are very rich in clay and their morphology suggests a high percentage of montmorillonitic clay with magnesium and sodium abundant in at least a part of them. Cultivation and water management would certainly be difficult. Still I have never seen more luxuriant natural grasses nor such a good surface turf on Tropical Black Clay. But this too can be misleading since these plants are quite different from those to be grown in agriculture. They are nearly pure carbohydrate. I saw no termite mounds although termites are abundant on the red soils at the margins of the valley.

Lunch seems to be a little slow at the hotel but we get away about 1:30 p.m. As we drive along on the plain just above the valley I note that most of the smooth red soils have been severely burned. Now beautiful flowers are springing into bloom very near the ground. At a distance they make one think of the crocus;

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but the flowers are shaped like those of the morning-glory. The thin dry forests on the Yellow-Red Latosols is nearly dormant, but some plants have flowers and some have new leaves. Only a very small proportion of this soil is used although I see some maize, bananas, and especially cassava.

Several miles north of Kiubo we pass a village with large baskets of recently picked cotton in the compound.

At around 3:40 p.m. we reach the Mitwaba airfield. We are away in the plane at 4:10 p.m. for the return journey to Elisabethville. On the way back there is a great deal of haze and smoke between us and the ground. The air clears as we approach Elisabethville. The forest is very beautiful with so many of the trees having new green leaves or new red leaves. We come into the airport at Elisabethville about 7:40 p.m. Jurion meets us and I'm taken to the Sabena Guest House. Few times in my life have I appreciated a bath more.

In the evening Jurion suggests a final dinner for Edelman, Tavernier, Stephens, the local INEAC director, and myself. We have a long discussion over the whole problems of the Lufira. Stephens, Edelman, and I are rather fearful of the possibilities of success on the Tropical Black Clay with gilgai. The brown soils on the levees are the best, but most of these are already occupied by the natives. Next comes the Red Latosol. We feel that those are the best soils in the Lufira Valley, but probably not quite so good as the Red Latosols near Elisabethville.

but the flowers are shaped like those of the morning-glory. The thin dry forests on the Yellow-Red Latosols is nearly dormant, but some plants have flowers and some have new leaves. Only a very small proportion of this soil is used although I see some maize, bananas, and especially cassava.

Several miles north of Kibbo we pass a village with large baskets of recently picked cotton in the compound.

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Those near Elisabethville have somewhat more rain and, of course, are much more convenient to transport and market. We point out that the hard rocks responsible for Kiubo Falls, are probably blocking the drainage of the valley. Thus if the lower part of the river channel could be deepened, the flood waters might not be so bad. The possibility is suggested of a huge earth dyke across the whole valley at a narrow point. Thus one would sacrifice the upper part of the valley in order to protect the lower part against the flood waters. Edelman seems to be a bit more afraid of the Black Tropical Clay with calcium sulphate than I am and favors the basin clay in the old meanders.

We have a lot of discussion about the need for fertilizers, especially high-analysis phosphatic fertilizer. We emphasize that men trained primarily in botany are likely to underrate the Red Latosols and overrate the Tropical Black Clay with gilgai because of the apparent differences in native vegetation. Edelman and I feel strongly that the Red Latosols in this area are the best soils and that it would be easier to correct the phosphate deficiency than it would be to cope with the tillage and drainage problems of the Tropical Black Clay. But if one goes in this direction investments for developing some of the best soils around Elisabethville would probably pay off more than investments so far away in the Lufira Valley. It is clear to me that someone has put forward the idea that the Lufira Valley is a potential "breadbasket for the Haut Katanga," and that there is

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a certain amount of political pressure to go ahead in the Lufira.

My own recommendation is that INEAC might pick out a small tract of the Tropical Black Clay for experimental study in order to see what might be done. I should favor rice over wheat. I am rather doubtful of economic success but I feel that the experiments should begin.

Early to bed.

a certain amount of political pressure to go ahead in the future.

My own recommendation is that INEAC might pick out a small tract of the Tropical Black Clay for experimental study in order to see what might be done. I should favor rice over wheat. I am rather doubtful of economic success but I feel that the experiments should begin.

Early to bed.

September 7

I'm up early and pack for the plane trip to Leopoldville. I go to the air field on the little bus and check in. Then Jurion comes to see me off. A nice air hostess takes my hat and puts it in a good seat in the plane. It is with great regret that I take leave of Jurion, who is one of the few great men that I know personally. I find that both Brammer and Charter are also taking the same plane. (Just as I get into the plane someone gives me the comforting news that 24 people were killed on a KLM plane at Shannon, Ireland two days ago!) We are in the air at 7:40 a.m. We drop down for a few minutes at Kolwezi. Here the soil is very sandy, at least on the surface. We stop for a moment in Baka, also on a sandy plain. We are down for lunch at Lulluabourg and leave again about 1:00 p.m. We stop at a small station called Kikwit. The soil is dry and sandy and the place looks pretty dreary except for a few nice Frangipanni shrubs. These now have medium-large creamy white, sweet-smelling flowers, but no leaves.

We are in the air again at 2:00 p.m., Leopoldville time and are down in Leopoldville at 3:30. I go to the Memling Hotel where I stayed before, but they have no room so I take my packages left there and go on over to the Regina. I have a big job sorting things out.

After dinner with Charter and Brammer I address my kodachromes for mailing in Belgium. This is a very noisy hotel.

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After dinner with Charter and Brammer I address my kodachromes for mailing in Belgium. This is a very noisy hotel.

There follows a group of photographs given to me by our Belgian hosts.

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Pygmy with net, spear, bow, and arrows for hunting.

AU CONGO BELGE

Pygmée portant à la chasse avec ses filets et ses armes tradi-
tionnelles.

Net, spear, bow and arrows, a Pygmy goes hunting.

64a

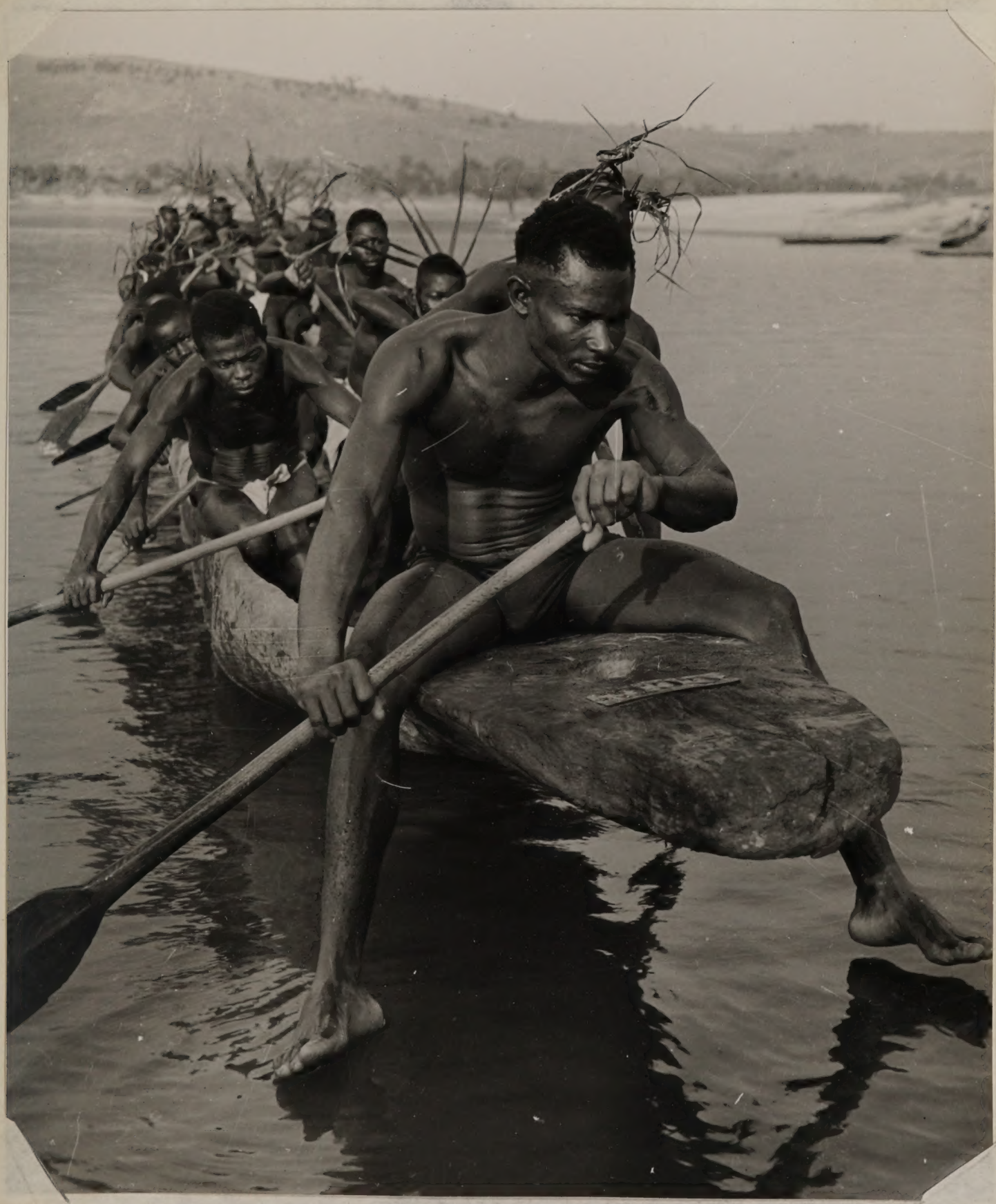
Photo Cdt. Dandoy.

Localisation: Territoire: Epulu - District: Kibali-Ituri
Province Orientale.

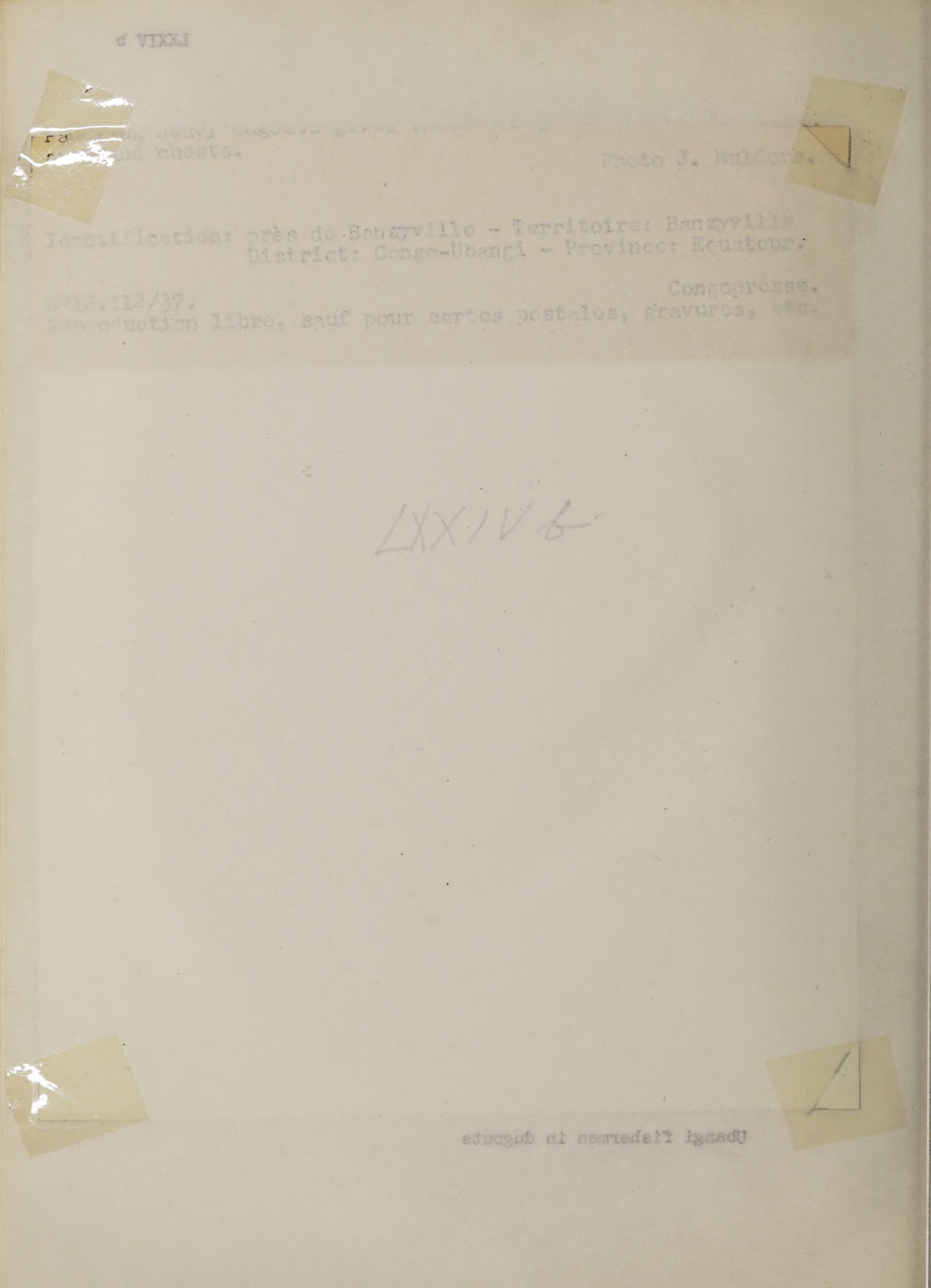
Congopresse.

Réf. 111/21.
Reproduction libre, sauf pour cartes postales, gravures, etc.

Pygmy with net, spear, bow, and arrows for hunting.



Ubangi fishermen in dugouts



Young mother and child

AU CONGO BELGE.
Femme Bakongo et son bébé.

The proud smile of young motherhood.

Photo H. Goldstein.

Localification: Territoire: Thysville - District: Bas-Congo
Province: Léopoldville.

Congopresse.

Young mother and child

Mangbetu with elongated skull.

AU CONGO BELGE.

Jeune fille Mangbetu de la Province Orientale.

The Mangbetu of the Eastern Province are extremely proud of their artificially elongated skulls.

Congopresse.

Mangbetu with elongated skull.

Mupende girl. Her hair is done in small plaits dipped in a mixture of oil and clay.

AU CONGO BELGE

Jeune fille de la tribu des Bapende.

La chevelure est disposée en petites tresses, durcies par un mélange d'huile et de boue, qui retombent tout autour de la tête.

Mupende Girl (Central Kwango). Her hair is done in small braids dipped in a mixture of oil and clay.

Photo J. Mulders.

Identification: Localité: Kinguba - Territoire: Gungu
District: Kwango - Province: Léopoldville.

Congopresse.

Réf. 172/11.

A termite mound in Lualaba, Katanga

Une terreitière entre Lusaba et Bukana, au Katanga.

A towering ant hill.

Photo H. Goldstein.

Identification: Territoire: Bukana - District: Lualaba
Province: Katanga.

Congopresse.

Réf. 3/6.

LXXIV f

A territe mound in Lualaba, Katanga

Termites

Photo H. Goldstein.

Localité: Pawa - Territoire: Wamba
District: Ituri - Province Orientale.

Congopress.

Reproduction libre, sauf pour cartes postales, gravures, etc.

LXXIV g

Sunset over the Congo River near Coquilhatville

Dipping cattle near Astrida, Ruanda

AU CONGO BELGE.

L'école des assistants agricoles africains d'Astrida: détail du dipping tank.

Cattle at the dipping tank (Astrida School for African Agricultural Assistants).

Photo C. Lemoto.

Identification: Localité et Territoire: Astrida
Résidence: du Ruanda.

Congo-Grosse.

Ref. 23.49/5.
Reproduction libre, sauf pour cartes postales, gravures, etc.

LXXIVi

Dipping cattle near Astrida, Ruanda

INXIA 1

Clearing a corridor near Bambesa

AU CONGO BELGE

Aménagement des terres en paysannat. Les plus grands chefs aux Noirs.

Preparing the site for an African Peasants Settlement.

Identification: Région de Bambesa - Territoire: Buta
District: Uele - Province Orientale.

Photo H. Goldstein.

Congopresse.

N°40.42/9.

LXXIV j

Clearing a corridor near Bambesa

September 8

This hotel was noisy in the evening but the street noise is worse in the early morning. After an early breakfast I take a cab to the American Consulate where I meet Mr. Yost, Mr. Drew, and Mr. McGregor, the Consul-General. I take with me my field equipment and some more papers which they agree to send immediately by surface mail to the United States.[1/]

I have a long and interesting discussion with the Consul-General. I review our excursions and meetings and we exchange impressions of the future of the Congo. I suggest the need for some sort of special company, supported by all American commercial concerns, with offices in Leopoldville and New York, for expediting the delivery of spare parts. The present very slow service on spare parts is seriously curtailing American imports.

Then I return to my room and complete the packing for the journey to Europe. I leave the hotel and check into the airport around 3:00 p.m. and find that the plane has been delayed. After a wait in the air station they take us back to the Sabena Guest House. Here I have an interesting talk with two wealthy Americans from Chicago who are just returning from a hunting trip (of course, they call it a safari!) in East Africa. I'm a bit amazed at their

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evaluation of all the places they have been in strict accordance with the extent to which they have found conveniences characteristic of the best American hotels! Now they have spent much time and money and yet they haven't the slightest notion of conditions and problems in Africa.

We finally take off from Leopoldville at 6:30 p.m. We are served a wonderful dinner and come down at Kano at 11:10 p.m. I bargain again with the notorious Arab traders of Kano, but buy nothing.

We are off again at midnight.

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We are off again at midnight.

September 9

This is my first experience with an air sleeper. It is a pleasant enough place to stretch out but my sleep was not very sound. I'm up about 7:00 a.m. and find we are over the sea and away from Africa. About 7:15 a.m. I am served that hateful and contemptible thing called the continental breakfast! At about 8:50 a.m. we are down in Geneva where we are served a proper breakfast, except that it comes pretty late. We are in the air again at 9:40 a.m. and down in Brussels airport at 11:20 a.m.

Here I'm met by Mr. Stanner and Symers of the Ministry of Colonies and INEAC. They take me to the hotel Metropole and tell me that I am due for a dinner tonight chez Madam Jurion. They offer to take me to an art exhibit in Antwerp, but I simply cannot take it.

When I get to my room I discover I have lost my suitcase key for the second time. I finally get the case open and decide to buy a strap and never to lock it again. I try to rest for awhile but this is difficult in the middle of the day. Later I call at the American Embassy and then take a walk over to the City Hall, one of the most beautiful spots in Europe. Later in the afternoon I meet Dr. Guy Smith who came in yesterday for the soils conference next week in Ghent.

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A little after 7 Mr. Symers takes me to the home of Madam Jurion. This is a very elaborate party with a full-course dinner. Present are : M. and Mme. Stanner, Mme. LeBrun, M. Van den Abeele, M. and Mme. Symers, and the mother of M. Symers, Jurion's sister.

Finally about 11:00 p.m. I explain to my hostess that I simply must go back to the hotel.

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September 10

I'm up without any real good sleep for some reason. I have breakfast with Guy Smith and at about 9:30 Professor Tavernier comes to the hotel directly from his plane from Elisabethville. He has a very tiny car and driver and all of us pile into this little car with our baggage. Frankly I don't see how we do it and neither can the doorman at the hotel.

We drive to Tavernier's home in Ghent. He shows us his nice garden and we have lunch. I try for about two hours to get some sleep without any luck.

In the evening we have dinner and talk about the coming conference next week. The Taverniers have three boys: Dirk, 13; Stepheen, 11; and Karel, 2½. The older boy is one of the nicest young fellows I have ever met. His home language is Flemish; he has been studying Greek, Latin, and French for some time; now he is just starting English; and next year he will begin German. What with mathematics and other subjects I can see that the schoolboy here has very little time for play, as compared with the American schoolboy.

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K-2329 Sept. 11, 1954. Belgium. Rear of Tavernier's home. Ryssenberg 89, Ghent.

K-2330 Sept. 11, 1954. Belgium, Ghent. Front of Tavernier's home and green grocer.

September 11

In the forenoon we go over to the Soil Survey office and have a good look at the map compilation section, library, and the laboratories. I am very much impressed with the work they are doing with the electron microscope on clay minerals and several other subjects. After a late lunch we take a tour of the market and the book stalls in Ghent. After dinner Tavernier takes us down to see the illuminated fountains and flower gardens, which are very nice indeed.

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September 12

I'm up to a cool rainy Sunday morning with a bit of dread for the journey to London. Tavernier takes us for a tour of the city including the old guild halls. After lunch we have some more talk about the problems in connection with the revised scheme for soil classification that will be discussed in Ghent next week. About 5:00 p.m. Tavernier takes me to the airport east of Brussels and I'm in the air again at 7:45 p.m. We come into the London airport at 9:05 p.m. It is a long, long way to my hotel, the Dorchester, and I get to bed at 11:00 p.m.

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K-2331 Sept. 11, 1954. Belgium. Canal in Ghent. Guild halls on left.

K-2332 Sept. 11, 1954. Belgium. Guild halls, Ghent. The center one dates from the 12th century.

K-2331 Sept. 11, 1954. Belgium. Canal in Ghent. Guild hall's on left.

K-2332 Sept. 11, 1954. Belgium. Guild hall, Ghent. The center one dates from the 12th century.

K-2333 Sept. 11, 1954. Belgium. Ghent. Some of the streets are narrow.

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September 13

In the morning I write letters to Madame Jurion and Madame Tavernier and to Whalley Taylor. I check my plane reservations and leave St. Pancras Station for Harpenden at 9:05 a.m. This is a beautiful cool sunny morning. At Rothamsted I spend most of the morning with Bloomfield in the Pedology Department and he tells me of his recent work in soil genesis, and especially about the influence of vegetation on iron. I am especially interested in the part that extracts of aspen leaves, in contrast to those of pine and spruce needles, do not lose their reducing effect with increased pH. This may explain the neutral Gray-wooded soils.

I also have a brief talk with the head of the plant pathology section, Mr. Bowden, about the problems of swollen shoot in the Gold Coast. He apparently doesn't think much of the leaf test for swollen shoot that the boys explained to me in Accra. Bloomfield and I have lunch together and then I see Jacks for a few minutes.

Despite the beautiful morning it is now raining and Mr. King takes me to the home of Mrs. Muir. We have a nice chat over tea.

In the early evening I take the train back to London. I have a long evening in the hotel for assembling my notes and writing letters.

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September 14

A minor crisis breaks out this morning. When I get up at 7:00 a.m. I find that my closet door had automatically locked and I cannot open it. Beyond this closet door are all my clothes and, worst of all, a little box of fruit for an early breakfast! I call the maid, shoe porter, and the hall porter. They try to explain to me that there will be no carpenters until 8. Now certainly I am not going to sit here for an hour waiting for my clothes and especially for the box of fruit. With little restraint, I teach them some colorful American expressions with which I pay my respects to the hotel. This gets results. The door is forced and all is soon quiet again.

After breakfast I call on Eric Englund at the American Embassy and we talk about the work of his office. (Eric still talks a continual blue streak, and only about what he is personally interested in at the moment.)

From the embassy I make an appointment with G. W. Nye, of the Colonial Office. We have a very nice chat about the work in Africa. I tell him about my trip and my impressions in the Gold Coast and give him a summary of the two meetings at Leopoldville. He expressed a surprisingly keen interest to have a copy of my proposed summary to Mr. Mead. He promises to help get Charter to the U. S.

I decide to walk back from the Colonial Office. I stop for a little while in Westminster Abbey; have lunch; prowl around a few book shops; do a little shopping in Liberty's; and get my train tickets for tomorrow.

I have another quiet evening "at home".

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September 15

I'm up early and pack for the trip north. This is a cold, gray rainy morning. I leave Paddington Station at 9:00 a.m. and arrive at Wolverhampton just before noon. Whalley Taylor meets me and takes me to his home. I find it very cold here despite a small electric fire in the living room.

In the afternoon Taylor takes me over to the headquarters of the West Midlands Provincial staff of the National Agricultural Advisory Service for England and Wales. There are 8 such staffs, with 7 for England and one for Wales. Scotland has a different arrangement, with the advisors tied more closely to the universities. Taylor tells me that up to 1946 he would have said that the Advisory Service was organized on a county basis something like the Extension Service in the United States. A new organization was brought about during wartime under a national government. During wartime the county committees did such a good job that they have been maintained, although now there is a good deal less for them to do. No legal link exists between the universities and the Advisory Service, although there is a great deal of informal cooperation of which he gives me several examples. Some of these, like the drainage and fertilizer work of Dr. Russell at Oxford, are already known to me. Mr. Taylor himself is the provincial leader for poultry work. Rather than attempt to list all the staff I am including in the Appendix (item 28) a reasonably up-to-date list of the staff of this provincial office and of that in the constituent counties that make up this region.

September 15

I'm up early and pack for the trip north. This is a cold, gray rainy morning. I leave Paddington Station at 9:00 a.m. and arrive at Wolverhampton just before noon. Whalley Taylor meets me and takes me to his home. I find it very cold here despite a small electric fire in the living room.

In the afternoon Taylor takes me over to the headquarters of the West Midlands Provincial staff of the National Agricultural Advisory Service for England and Wales. There are 8 such staffs, with 7 for England and one for Wales. Scotland has a different arrangement, with the advisors tied more closely to the universities. Taylor tells me that up to 1946 he would have said that the Advisory Service was organized on a county basis something like the Extension Service in the United States. A new organization was brought about during wartime under a national government. During wartime the county committees did such a good job that they have been maintained, although now there is a good deal less for them to do. No legal link exists between the universities and the Advisory Service, although there is a great deal of informal cooperation of which he gives me several examples. Some of these, like the drainage and fertilizer work of Dr. Russell at Oxford, are already known to me. Mr. Taylor himself is the provincial leader for poultry work. Rather than attempt to list all the staff I am including in the Appendix (item 28) a reasonably up-to-date list of the staff of this provincial office and of that in the constituent counties that make up this region.

THE EIGHT PROVINCES OF THE N·A·A·S

SHOWING PROVINCIAL CENTRES AND SUB-CENTRES

Besides what we regard as strictly Extension in our advisory work in the United States, this organization gives some technical assistance and some empirical testing that is handled by either the Soil Conservation Service or the State experiment stations in the United States. The provincial office has laboratories for soil testing and other analytical work, pathology laboratories, and the like. Thus there are advisors for both the scientific and husbandry phases of agriculture at the provincial offices. They have a good library and also good service from the central library in London.

Taylor tells me that many of the people on the advisory staff give lectures at the universities but they avoid having any of their people involved in giving whole courses or a complete system of lectures.

Under Robert Ray, Director of the National Agricultural Advisory Service in London, there are a few top specialists, such as a chief husbandry officer, a scientific officer, a chief livestock officer, a chief poultry officer, and a chief horticultural officer.

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Each province has roughly the same areas. (See map) Because of the enormous differences among counties, a province may have 4 to 12 counties in its area. Within each county the agricultural officer in charge may have specialists on his staff according to need. Then the counties are divided into districts so that a district officer, roughly corresponding to our county agent as a general practitioner, has roughly 800 to 1,000 farms to deal with. Thus the organization is a characteristic "line-and-staff" set-up.

Taylor tells me that members of the county boards are wholly volunteer and unpaid. Members are compensated only for out-of-pocket expenses. The plans call for a board of 12 people. Three represent landowners; three represent agricultural workers; and others represent the local educational authority and the National Farmers Union. The farm labor unions elect their members. Under this general committee are organized subcommittees to deal with specific subjects.

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During the war the county agricultural officers were responsible to this committee as well as to the national Ministry of Agriculture. The committees still have a heavy responsibility for the subsidy program and some for the contract services for handling common land; although most of the common land has been turned back to the communities that held it originally.

I press him about the power of the agricultural committees to dispossess farmers which has gotten so much publicity in the United States. He tells me that in the first 4 years of the operation of this provision only 0.4 percent of the farmers were actually taken off the land.

We have some discussion about farm planning and technical assistance. I find that this is only little developed in Britain as compared to the United States. This is probably due to the absence of dramatic soil depletion. My observations would suggest that the biggest soil problems on most farms have to do with drainage, liming, fertilization, ley management, and field reorganization. I might add that it is still my view that these problems are surprisingly great in a highly developed country so pressed for food as Britain. As contrasted to 1947 and 1948, I feel they have done quite a bit with the phosphate problem. There is still a lot of land used for pasture that could be drained economically with modern methods. Personally, I should

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like to see some heavy equipment used to get rid of a lot of the stone fences and hedgerows. These take up space, cut up the farms into fields too small for the proper use of agricultural machinery, and harbor rabbits that prey on crops and pasture.

Mr. Taylor tells me that they are going a little bit into farm planning like that advocated by the Black school and in some of my former papers. They have some so-called "husbandry farms" in this province. Apparently these are somewhere between pilot research farms and demonstration farms, but likely a little closer to the latter than to the former. They are also doing some farm planning on as many as perhaps 1/10 of the farms in some areas.

I go through the chemistry section, which is heavily engaged in testing soil samples for pH, major nutrients, and some minor nutrients. In addition they make analyses of plant tissue partly to throw light on fertilizer needs but more to suggest nutritional adequacy. Certainly this laboratory is not above standard. Some parts are a bit dirty and in conversation with some of the workers I discover that they have only the vaguest idea of what they are doing or why.

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About 2:30 p.m. I go with Taylor to an advisory meeting on turkeys in Stafford County. There is a small exhibit and they have the usual talks and panel discussions on turkey production. Here I met the agricultural officer for this county, Mr. George Precious. I shall have to admit that the combination of my unfamiliarity with the jargon of turkey operations and the accent of the growers, makes it difficult for me to follow all the discussions. On the whole, I feel that this meeting is not much different from a similar one in our country.

In the evening I attend a dinner at the local pub as a guest of the more prominent turkey growers.

Back with Taylor and to bed about midnight.

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Back with Taylor and to bed about midnight.

CHEMISTRY DEPARTMENT

WEST MIDLAND PROVINCE

NATIONAL AGRICULTURAL ADVISORY SERVICE

Staff

Analysts

A. J. Cavell, M.Sc., A.R.C.S., D.I.C., F.R.I.C.
S. Graham, A.R.I.C.
Miss M. C. Paterson, B.Sc.
Miss D. Lamb

Nutrition Chemists

J. Featherstone, M.Sc., A.R.I.C.
T. W. Griffiths, B.Sc., A.R.I.C.

Soil Chemists

J. O. Jones, M.Sc., F.R.I.C.
G. H. A. Edwards, B.A.
C. G. Sherrell, B.Sc.

Assistants (Scientific)

M. R. Dixon
J. M. James
E. J. Walker
Miss D. W. B. Boyden
Miss E. A. B. Brennan
Miss S. M. Fletcher
Miss M. E. Gwinnett
Mrs. D. M. Shaw
Miss H. M. S. Smith
Miss M. Stewart
Miss V. F. Webb

Field Assistants

F. J. Dickens, N.D.A.
J. J. Edwards
D. M. Garrett, N.D.A.
J. G. Lomas

Laboratory Attendant

F. F. Chew

The problems that advisory chemists in the National Agricultural Advisory Service have to deal with may be divided into two main groups, those relating to the soil and those connected with animal nutrition. The analytical work for the soil chemists and nutrition chemists is co-ordinated by the analysts.

Some idea of the volume of work done is reflected by the following lists of some of the samples analysed during 1953/4.

Nutrition Chemistry		Soil Chemistry	
Silage	572	Soils for routine analysis	25489
Hay	97	Soils for special analysis	611
Dried grass	103	Soils from experimental plots	1672
Fresh herbage	37	Liming materials	145
Poultry foods	50	Plant materials for mineral analysis	27
Roots	134	Plant materials from experimental plots	715
Milks	339	Fertilisers	72
Grains	140	Tests to assess nutrient status of plants	201
Cobalt in soils	34		
General foods	186		
Plant materials from experimental plots	686		

Most of the above samples were sent to the Advisory Chemists for advice by the District Officers in the six counties, Cheshire, Herefordshire, Shropshire, Staffordshire, Warwickshire and Worcestershire, which make up the West Midland Province.

Nutrition Chemistry

After the analysis of a feeding-stuff is completed the Nutrition Chemist usually gives routine advice on its feeding value for the purpose intended, e.g., how best to provide rations for cows or pigs using the material that has been examined.

Chemical analyses are also made to investigate problems that may involve nutritional deficiency, possible digestive disturbance or poisoning.

Milk analyses are undertaken for advisory purposes when farmers receive complaints from receiving depots that their milk is of low compositional quality.

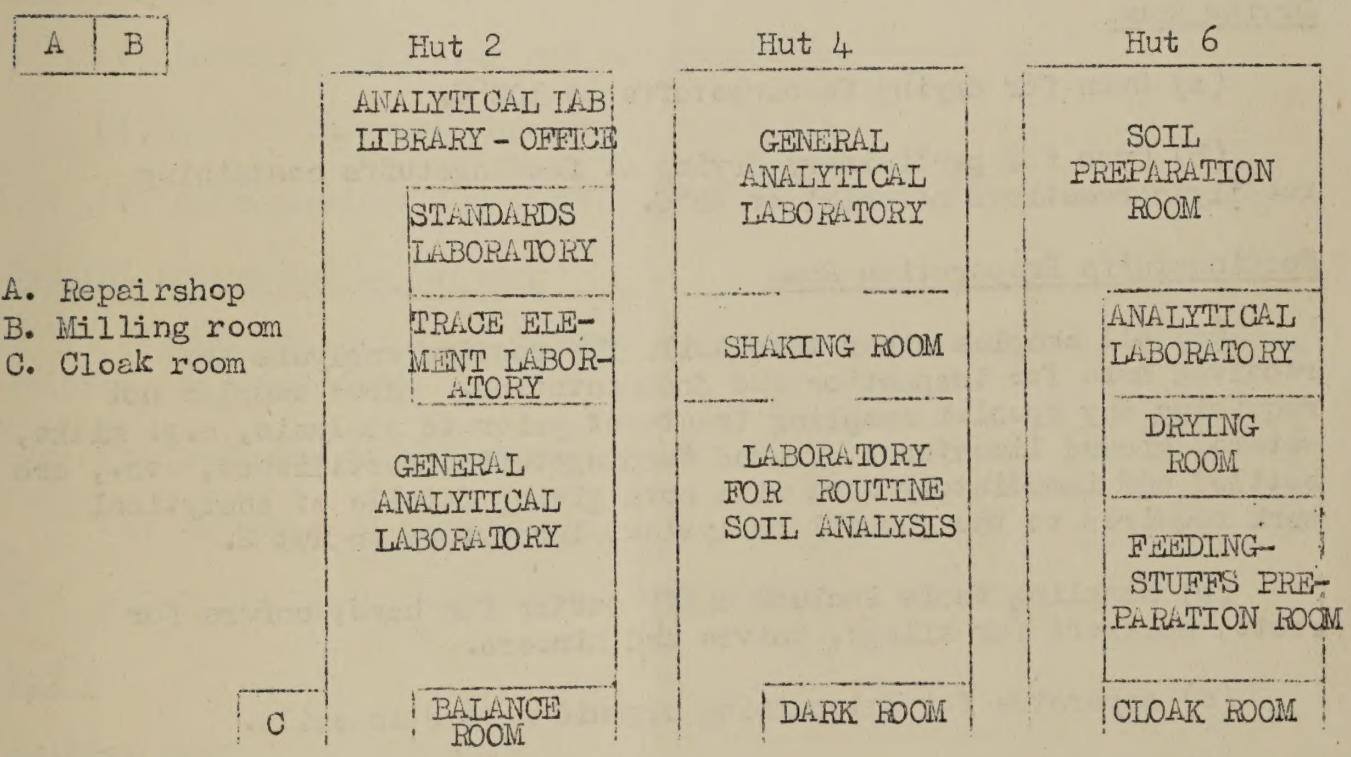
Soil Chemistry

The Soil Chemist gives routine advice on the manurial status of soils, particularly the phosphate and potash available in the soils and the amount of lime to be added to correct excessive acidity. Special chemical analyses are made on soils thought to have incorrect calcium or magnesium ratios or toxic properties, etc.

Chemical analyses are made to assess the value of organic fertilisers and liming materials and advice is given on the correct rate of application.

The results of tissue tests show the nutrient status of young plants and from them advice can be given to correct deficiencies in the soil, e.g., a deficiency of manganese, phosphate, potassium or nitrogen.

Plan of Laboratories



A storeroom for chemicals and laboratory apparatus is located in Hut 15. Inflammable liquids in bulk are stored in an out building.

Visitors to the laboratories may be interested in the apparatus, and methods of analysis in regular use, mentioned overleaf.

HUT 6

Soil Preparation Room

(a) Soils are received, numbered, dried, ground, weighed out for routine analysis in Hut 4, and finally stored here.

(b) Soil sampling tools used by soil samplers in the field.

(c) Soil drying oven.

Analytical Laboratory

(a) Tissue testing to assess rapidly the nutrient status of plants.

(b) Aggregate analysis of soils.

Drying Room

(a) Oven for drying feedingstuffs at 100°C.

(b) Oven for preliminary drying of feedingstuffs containing readily caramelised material at 60°C.

Feedingstuffs Preparation Room

(a) All samples other than soils for routine analysis are received here for inspection and documentation. Most samples not requiring any special sampling treatment prior to analysis, e.g. milks, waters, ground limestones, ground feedingstuffs, fertilisers, etc., are bottled and immediately sent with note giving details of analytical work required to the general analytical laboratory in Hut 2.

(b) Sampling tools include chaff cutter for hays, corers for roots, scissors for silage, knives and mincers.

(c) Apparatus for determining organic matter in soils.

(d) Apparatus for measuring conductivity of soil extracts.

(e) Collection of feedingstuffs and fertilisers.

HUT 4

Laboratory for Routine Soil Analysis

(a) Determination of available potash with a flame photometer.

(b) Determination of available phosphate with a Spekker absorptiometer.

(c) Determination of acidity of soils with pH meter.

(d) Determination of acidity with soil indicator solution.

(e) Apparatus for producing deionised water.

(f) Automatic measures.

Shaking Room

(a) Shakers: end over end and horizontal types.

(b) Muffle furnaces for ashing materials.

(c) Refrigerator for storage of chemicals at low temperatures.

General Analytical Laboratory

(a) Mineral analysis of plant materials for phosphorus, potassium, calcium and magnesium.

(b) Analysis of liming materials.

(c) Analysis of fertilisers.

(d) Determination of calcium and magnesium in soils.

HUT 2

Balance Room

(a) Sartorius balance which does not require the use of a box of weights.

(b) Oertling balance.

General Analytical Laboratory

(a) Analysis of feedingstuffs for moisture, fat, fibre and proteins.

(b) Analysis of soils for nitrogen and lime, or chalk content.

(c) Sugar analysis.

Trace Element Laboratory

(a) Analysis of plants and soils for such elements as copper, lead, zinc, manganese, cobalt, molybdenum, in trace and toxic quantities.

Standards Laboratory

(a) Preparation of standard solutions.

(b) Preparation of bench reagents.

(c) Water analysis.

(d) Milk analysis.

Analytical Laboratory - Library - Office

(a) Non-routine and investigation analytical work.

(b) Standard text books on analytical chemistry, and such journals as "Analytical Chemistry" and "The Analyst".

(c) Card index of published analytical methods.

(d) Reporting of non-routine soils and non-routine feedingstuffs.

(e) Ordering of apparatus and chemicals.

A. Repair Shop

(a) Repair and painting of laboratory apparatus.

B. Mill Room

(a) Before an analysis is made all dried plant materials are milled in a Christy-Norris Laboratory mill.

(b) Drying ovens, operating at about 80°C, used to keep samples which would pick up moisture from the air and then clog the mill, dry enough to be milled.

PAPERS PUBLISHED

1. Alternatives to Hay
   J. Featherstone,
   Agriculture 1947,54,68

2. The efficient use of Fertilisers on farm crops.
   T. W. Walker,
   Worc. Agr. Chron. 1948,16,273.

3. The Wise use of Lime,
   T.W.Walker,
   Hereford Agr. Jour. 1948,11,111.

4. Some effects on Soil Steaming
   T.W.Walker,
   Worc. Agr. Chron. 1948 16,153.

5. Memorandum on Solids-not-Fat in Milk
   J. Featherstone,
   N.A.A.S., Provincial Circulation 1949.

6. Some observations on the Chemical changes effected by the Steam Sterilization of glasshouse soils.
   T.W.Walker, and R.Thompson.
   J. Hort. Sci. 1949,25,19.

7. Maintaining Soil Fertility for Vegetables.
   T.W.Walker,
   Worc. Agric. Chron. 1950,18,119.

8. Variation in Composition of Cows' Milk during a Period of 12 Weeks
   J. Featherstone, C. D. Rickaby and A.J.Cavell,
   J. Dairy Res. 1951,18,155.

9. Making the most of Phosphate Supplies
   T.W.Walker,
   Agriculture 1951,58,305.

10. Variations in the Composition of Grassland Herbage
J. Featherstone, C. D. Rickaby and A. J. Cavell,
J. Brit. Grassland Soc. 1951, 6, 161.

11. Determination of Potassium in Soil Extracts with a Flame Photometer
A. J. Cavell,
Analyst 1952, 77,537.

12. Silage Feeding Investigation in the West Midlands 1951-52
J. Featherstone,
N.A.A.S. Provincial Circulation 1952.

13. Growth Response to Young Tomato Plants to Nitrogen, Phosphate & Potash
T. H. Rose and A. J. Cavell
Worc. Agr. Chron. 1952, 20, 277.

14. Relative Values of Alternative Liming Materials
E. M. Crowther and T. W. Walker
Agriculture 1952, 59, 251.

15. The Influence of Nitrogen on the Yield of Spring Wheat
T. W. Walker and D. H. Robinson,
Agriculture 1952, 58, 569

16. The Estimation of the Lime Requirements of Soils
T. W. Walker
J. Soil Sci. 1952, 3, 261

17. The Use of Fertilisers on Herbage Cut for Conservation
T. W. Walker, G. H. A. Edwards, A. J. Cavell and T. H. Rose
Part I J. Brit. Grassl. Soc. 1952, 7, 107
II J. Brit. Grassl. Soc. 1952, 7, 135
III J. Brit. Grassl. Soc. 1953, 8, 45

18. Influence of Nitrogen on the Yield of a Cocksfoot Seed Crop
J. Davies and G. H. A. Edwards
J. Brit. Grassl. Soc. 1953, 8, 261.

19. Making Better Use of Silage
T. W. Griffiths and J. Featherstone,
Agriculture 1953, 60, 409.

20. A Rapid method for the Determination of Nitrogen, Phosphorus and Potassium in Plant Materials.
A. J. Cavell,
J. Sci. Food & Agric. 1954, 5, 195.

MINISTRY OF AGRICULTURE & FISHERIES

ADVISORY SERVICES

STAFFORDSHIRE AGRICULTURAL EXECUTIVE COMMITTEE
IN CONJUNCTION WITH
THE STAFFORDSHIRE FARM INSTITUTE
and
THE WEST MIDLAND BRANCH OF THE
BRITISH TURKEY FEDERATION

TURKEY CONFERENCE

STAFFORDSHIRE FARM INSTITUTE

PENKRIDGE

STAFFORD

WEDNESDAY *15th SEPTEMBER, 1954*

at 1. 0 p.m.

NATIONAL AGRICULTURAL ADVISORY SERVICE

PROGRAMME

P.M.

2.00 **Opening Address**

H. E. Wells, Esq., B.Sc.,
Principal, Staffordshire Farm Institute

2.15 **"The Turkey Industry of Today"**

H. R. C. Kennedy, Esq., N.D.P.

2.30 **Marketing Panel**

Chairman Dr. W. P. Blount, Ph.D., F.R.C.V.S., F.R.S.E.

Panel J. F. Downes, Esq.,
T. H. Kennedy, Esq.,
W. M. Justice, Esq.
J. S. Lintern, Esq.

4.30 *TEA INTERVAL*

5.15 **Production Panel**

Chairman Major R. Waugh Harris

Panel Dr. R. F. Gorden, M.R.C.V.S.
W. R. Muir, Esq.
D. C. Llewellin, Esq.
F. E. Peele, Esq.

7.00 **Announcements of awards**

OPEN TURKEY COMPETITION

THREE CLASSES OF DEAD TURKEYS

All 1954 hatched, of either sex and any weight

ALL CLASSES TO BE JUDGED BY MEMBERS OF THE MARKETING PANEL

CLASS 1. CLEAN PLUCKED TURKEY

The turkey to be completely plucked except for half the neck. This class will be judged in a hanging position.

CLASS 2. PRESENTATION PACK

One turkey, dressed and "oven ready" Giblets wrapped separately. NO TRADE MARKS PERMITTED.

CLASS 3. MARKET PACK

Up to 6 birds but not less than 4 suitably packed for the market. NO TRADE MARKS PERMITTED.

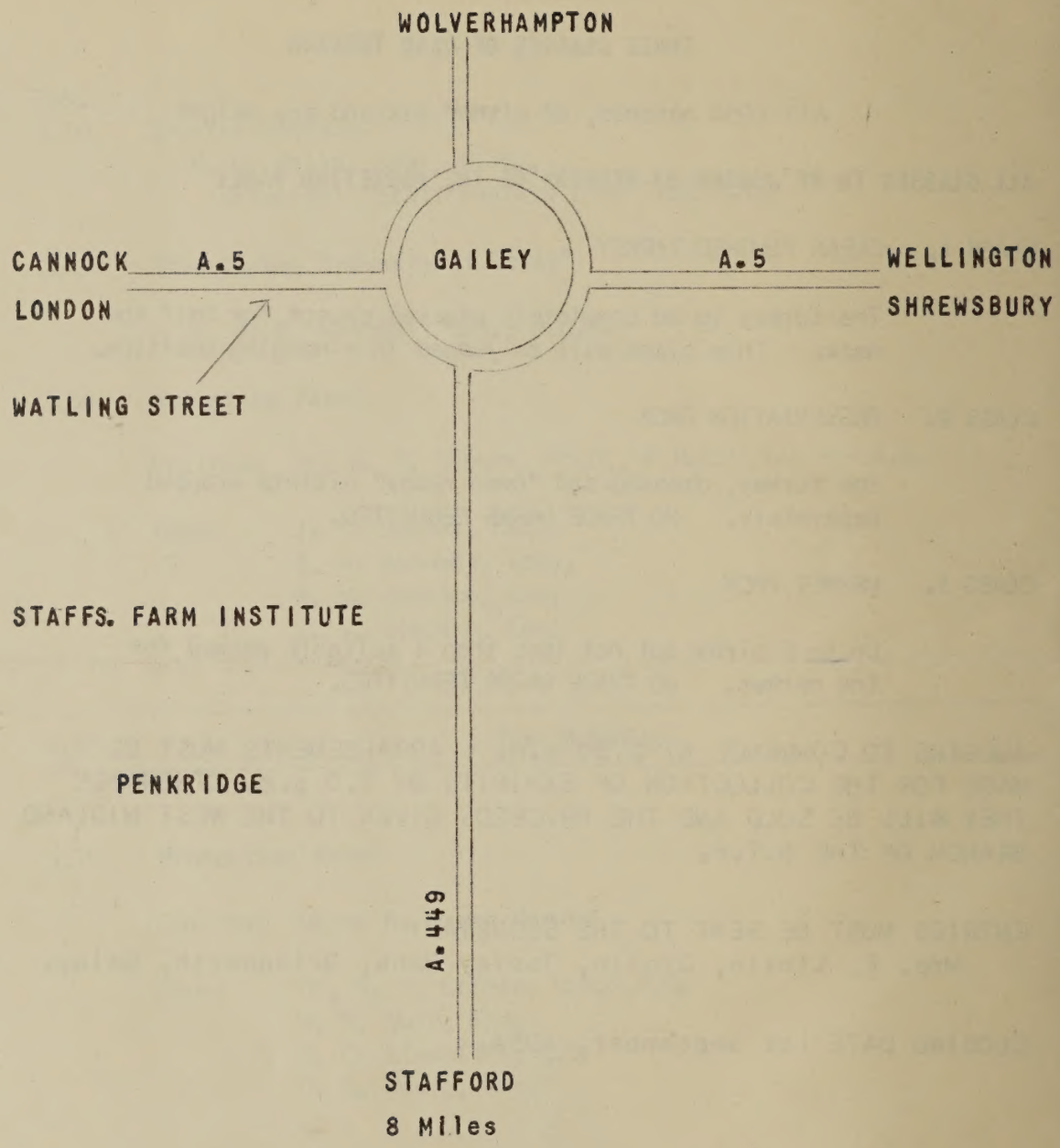
JUDGING TO COMMENCE AT 2.30 p.m. ARRANGEMENTS MUST BE MADE FOR THE COLLECTION OF EXHIBITS BY 7.0 p.m. OTHERWISE THEY WILL BE SOLD AND THE PROCEEDS GIVEN TO THE WEST MIDLAND BRANCH OF THE B.T.F.

ENTRIES MUST BE SENT TO THE SECRETARY
Mrs. E. Lintin, Crolin, Tasley Bank, Bridgnorth, Salop.

CLOSING DATE 1st September, 1954.

THERE WILL BE NO ENTRANCE FEE.

DS 20970/1(3)/R.127 6530 8/54 DL


WOLVERHAMPTON
CANNOCK
A.5
GAILEY
A.5
WELLINGTON
LONDON
SHREWSBURY
WATLING STREET
STAFFS. FARM INSTITUTE
PENKRIDGE
A.449
STAFFORD
8 Miles

September 16

It had been planned that I spend this day with the local soil survey party making a map of Shropshire County, lying west of Wolverhampton. The party chief is Mr. Mackney, a member of the National Soil Survey group under Dr. Muir. His assistant, Mr. Murdock, had received leave from his tour of duty in the military reserves, Air Force I believe, for my visit. Messrs. Jones and Edwards, soil chemists in the laboratory of the provincial office, go along. Although sunny part of the time, this is a cold and windy day and everything is quite wet.

We go west of Wolverhampton through Bridgenorth over an old sandstone formation with boulder clay (till and other drift) above it. Our first stop is to look at a silty clay loam from high-calcium limestone. The soil is non-arable but useful for pasture.

The soil pattern is very complicated here. Most of the fields run 5 to 10 acres and are bounded by high hedges. We pass Shipton and I notice that most of the farms run about 50 percent grass with the remainder of the land in sugarbeets and wheat. Most of the roads and fields have relatively high hedges, which I regard as nuisances. There is much sheep-growing and poultry-raising in this region.

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CARDIGAN BAY
Tremadoc Bay
MERIONETH
CARDIGAN
MONTGO
RAD
Criccieth
Pwllheli
Abererch
Llannor
Efail-newydd
Denio
Penrhos
Llanbedrog
Myntho
Abersoch
St. Tudwal's Road
St. Tudwal's I East
St. Tudwal's I West
Porth Neigwl or Hell's Mouth
Llanengan
Sarn-bach
Bwlch-y-tocyn
Porth Caered
Trwyn yr Wylfa
Trwyn Cilan
Rhiw
Plâs-Neigul
Llandegwning
Llangian
Bottwnog
Meyllteyrn
Sarn-Meyllteyrn
Llaniestyn
Llanfihangel Bachellaeth
Carn Fadryn
Dinas
Llandudwen
Twdweiliog
Ceidio
West End
Coreg yr Imbill
Pen-ychon
Borth-y-gêst
Port Meirion
Afon Glaslyn
Harlech Point
Llanfihangel-y-traethau
Talsarnau
Eisingrug
Glyn Cywarch
Morfa Harlech
Mdrfa
Lasynys
Harlech
Llanfair
Wern-gron
Gwynfryn
Llanbedr
Nantcol
Rhinog Fawr 2362
Rhinog Fâch
Moel Ysgyfarnogod
Llyn Cwm-bychan
Llandecwyn
Pont Islyn
Trawsfynydd
Fron-oleu
Cwm Prysor
Arenig Fawr
Moel Llyfnant
Bryn-Eden
Afon Eden
Nant Gâmol
Moel y Feidiog
Mynydd Bach
Mynydd Brynllech
Rhobell
Llanenddwyn
Dyffryn
Morfa Dyffryn
Tal-y-bont
Llyn Bodlyn
Diphwys
Llawllech
Afon Cwm Mynach
Craig y Cae
Y Garn
Ganllwyd
Moel Cors-y-Garnedd
Llanfachreth
Bont Newydd
Wenallt
Henfaes
Aran Benllyn
Aran Fawddwy 2970
Foel Rhudd
Bala
Llanfor
Llanycil
Llyn Tegid (Bala Lake)
Llangower
Rhos-y-gwaliau
Aber-Hirnant
Parc
Afon Llafar
Pen-y-bont
Llanuwchllyn
Dylluan
Talardd
Ty-nant
Foel Figenau
Cwm Cynllwyd
Nant Rhyd wen
Cwm Hirnant
Llandrillo
Cefn Coch
Dinam
Post Gwyn
Pencraig
Llangynog
Hirnant
Lake Vyrnwy
Vyrnwy Aqueduct
Llanwddyn
Pen y Bylchau
Afon Cownwy
Hen Gerig
Pen y Ffridd-Cownwy
Afon Eiarth
Llanelltyd
Penmaenpool
Afon Mawddach
Afon Wnion
Brithdir
Bontddu
Llanaber
Barmouth
Barmouth Bay
Aber-Gwynant
Dolgelley
Rhyd-wen
Bryn Brith
Dyffrydan
Capel-Arthog
Fairbourne
Ynys-gyffglog
Friog
Fox's Path
Llyn Gader
Cader Idris 2927
Llyn Cau
Tyrrau Mawr
Mynydd Pencoed
Craig y Llyn
Mynydd Pennant
Pen y Garn
Cross Foxes Farm
Waen Oer
Cribin Fawr 2197
Coe Afon
2213
Mynydd Ceiswyn
Mynydd Dolgoed
Tal y Mieryn
Foel y Ffridd
Cae'r-tyddyn
Y Gribin
Terwyn
Llanymawddwy
Careg y Fran
Tir Rhiwiog
Moel y Llyn
Dinas-Mawddwy
Minllyn
Mallwyd
Nant-y-dugoed
Afon Banwy
Foel
Garthbeibio
Mynydd y Gadfa
Llwydwarth Park
Pont-Llogel
Dolanog
Pen-y-bont
Llangadfan
Llanerfyl
Carnedd Wen 1716
Talalog
Pen y Coed
Ty-newydd
Llyn Gwyddior
Nant yr Eira
Bryn y Castell
Clegyrnant
Llyn Hir
Esgair Ddu
Aberangell
Cwm Llinau
Cemmaes
Mynydd y Cemmaes
Cemmaes Road
Waun
Wynnstay
Talolwern
Commins-côch
Abercegir
Darowen
Llanbrynmair
Bont-dolgadfan
Natural Arch
Talerddig
Twmpath Melyn
Llanllugan
Llanwyddelan
Mynydd Clogau
Dol-ffanog
Tal-y-llyn Lake
Aberllefenni
Tal-y-llyn
Upper Corris
Corris
Graig Goch
Taren y Gesail
Esgair Geiliog
Abergynolwyn
Pant-perthog
Llanfihangel-y-Pennant
Llwyngwril
Afon Dysynni
Llangelynin
Llanegryn
Dyffryn Dysynni
Rhos-lefain
Ton-fanau
Broad Water
Bryn-crug
Pandy
Mynydd Tan y Coed
Dol-gôch
Torren Hendre 2076
Trum Gelli
Towyn
Esguan Hall
Corlan Fraith
Pant yr Ôn
Cwrt
Pennal
Talgarth
Dovey Valley
Machynlleth
Penegoes
Derwen-las
Aberdovey
River Dovey
Garreg
Ysgubor-y-coed
Aberhosan
Moelfre
Pennant
Bryn Amlwg
Tronnon
Pont Crygnant
Afon Twymyn
Dylife
Sarn
Carno
Llyn Mawr
Llyn y Tarw
Llanwnog
Caersws
Penstrowed
Aberhafesp
Glaslyn
Bugeilyn
Staylittle
Llawr-y-glyn
Trefeglwys
Llyn Ebyr
Llandinam
Moel y Llyn
Twyni Bach
Ynys Tachwedd
Fochno
Llancynfelyn
Tre'r-ddol
Tre-Taliesin
Cors Fochno
Stavlittle
Talybont
Borth
Upper Borth
Dol-y-bont
Llandre
Elerch
Sarn Cynfelyn
Bow Street
Salem
Glan-y-mor
Llangorwen
Penrhyn-côch
Pen-bont-rhyd-y-beddau
Cwm-symlog
Cefn-llwyd
Capel Dewi
Dollwen
Goginan
Aberystwyth
Dorglwyd
Llanbadarn-fawr
Capel Bangor
Pont-erwyd
Dyffryn-castell
Ty'n-y-fordd
Afon Rheidol
Disgwylfa Fawr
Carn Gwilym
Source of R. Severn
Pen Plynlimonfawr 2468
Plynlimon Arwystli 2427
Plynlimon Fawr
Source of R. Wye
Drum Peithnant
Esgair y Maesnant
Tor Du
Y Foel
Afon Clywedog
Bryn y Tail
River Severn
Llanidloes
Lower Pen-rhuddlan
Upper Pen-rhuddlan
Moendre
Cwm-belan
Pen Dinewid
R. Wye
Esgair Ychion
Llangurig
Tylwch
Oldhope Hill
Llyn-dŵr Hill
1920
Rhiw Hywel
Yspytty Cynfyn
Devil's Bridge
Mynydd-bach
Chancery
New Cross
Llanfihangel-y-Creuddyn
Llanilar
Blaen-y-cwm
Bryn
Cwm Ystwyth
Geifas
Bont Nant Rhys
Dolfach
Sychnant
Cefn Cenarth
Pistyll
Red Lion Hill
Dyrysgol
Bryn Titley
Pant-y-dŵr
St. Harmon
Cefn Crin
Dol-helfa
Afon Elan
Pont ar Elan
Llanafan
Afon Ystwyth
Pont-rhyd-y-groes
Ysbyty Ystwyth
Trawsallt
Craig-yr-allt-goch Res.
Hirnant
Gamallt
Moel Hywel
Camlo Hill
Llandeiniol
Llangwyryfon
Lledrod
Llanrhystyd
Mabws
Bronant
Ystrad-Meurig
Ffair-rhôs
Pontrhydfendigaid
Strata-Florida
Swydd-ffynnon
Ynys
Dibyn Du
Trumau
Pen-y-garreg Res.
Garreg-ddu Res.
Claerwen Res.
Llansantffraid Cwmdeuddwr
Rhayader
Gwastedyn Hill
Nantmel
Gaufron
Elan Village
Llanfihangel-helygen
Llanwrthwl
Caban-côch Res.
Argoed Mill
Llanyre
Llansantffraid
Llanon
Mynydd Bach
Nebo
Blaenpennal
Maes-elwad
Pen y Bwlch
Esgair Llyn-du
Esgair Garthen
Bryn Garw
Pen Maen-wern
Garn Gron
Gamrhiw
Drum Ddu
Aber-Arth
Aberayron
Llanddewi-Aberarth
Upper
Pennant
Cross Inn
Llanbedarn Trefeglwys
Tyn-y-swydd
Cainer-fawr
Rhiwlas
Llanbadarn Odwyn
Llangeitho
Tregaron
New Quay Hd
New Quay
Henfynyw Upper
Llanina
Llwyn-celyn
Neuadd
Cilcennin
Nantcwille
Capel-Bettws-Lleucu
Aeron
Ciliau-Aeron
Brynog
Trefilan
Garthelio
Talsarn
Llundain-fâch
Llanllwchaiarn
Llanarth
Oakford
Dihewid
Llandyssiliogogo
Llwyn Dafydd
Mydroilin
Llanfihangel-Ystrad
Felindre
Temple Bar
Ynys Lochdyn
Llangranog
Post-mawr
Penbryn
Aberporth
Cribyn
Silian
Bettws-Bledrws
Llanfair-Clydogau
Llangybi
Garth
Llanddewi-Brefi
Esgair Llethi
Y Drum
Esgair Afnor
Llyn Berwyn
Camddwr
Drum yr Eira
Drygarn Fawr 2115
Careg yr Ast
Gorllwyn 2009
Bryn Crwn
Irfon
Cefn Côch
Abergwesyn
Cefn Crûg
Cefn Fanog
Pen Rhiw-clochdy
Pen-y-Gurnos
Beulah
Bryn
Llanafan-fawr
Cribarth
Llanfihangel-Bryn-Pabuan
Newbridge on Wye
Chwefru
Coed-mawr
Builth Road
Llangamarch
Cefn-y-bedd
Llanelwedd
Rhôs-yr-hafod
N.T.
Newport
Caerleon
Malpas
Bettws
Christchurch
Maindee
Lis-werry
Pillgwenlly
Rogerstone
Machen
Upper Machen
Pont-y-mister
Rhiwderyn
Ebbw River
River Usk
Nash
Michaelstone-y-Vedw
Coedkernew
Castleton
Began
Marshfield
St. Mellons
Peterstone Wentlloog
St. Bride's Wentlloog
Rhymney River
Rumney
Cardiff
Lavernock Pt.
Flat Holme
Steep Holme
Swallow Cliff
Sand Bay
Kewstoke
Worlebury Camp
Milton
Birnbeck I.
Weston-super-Mare
Bristol
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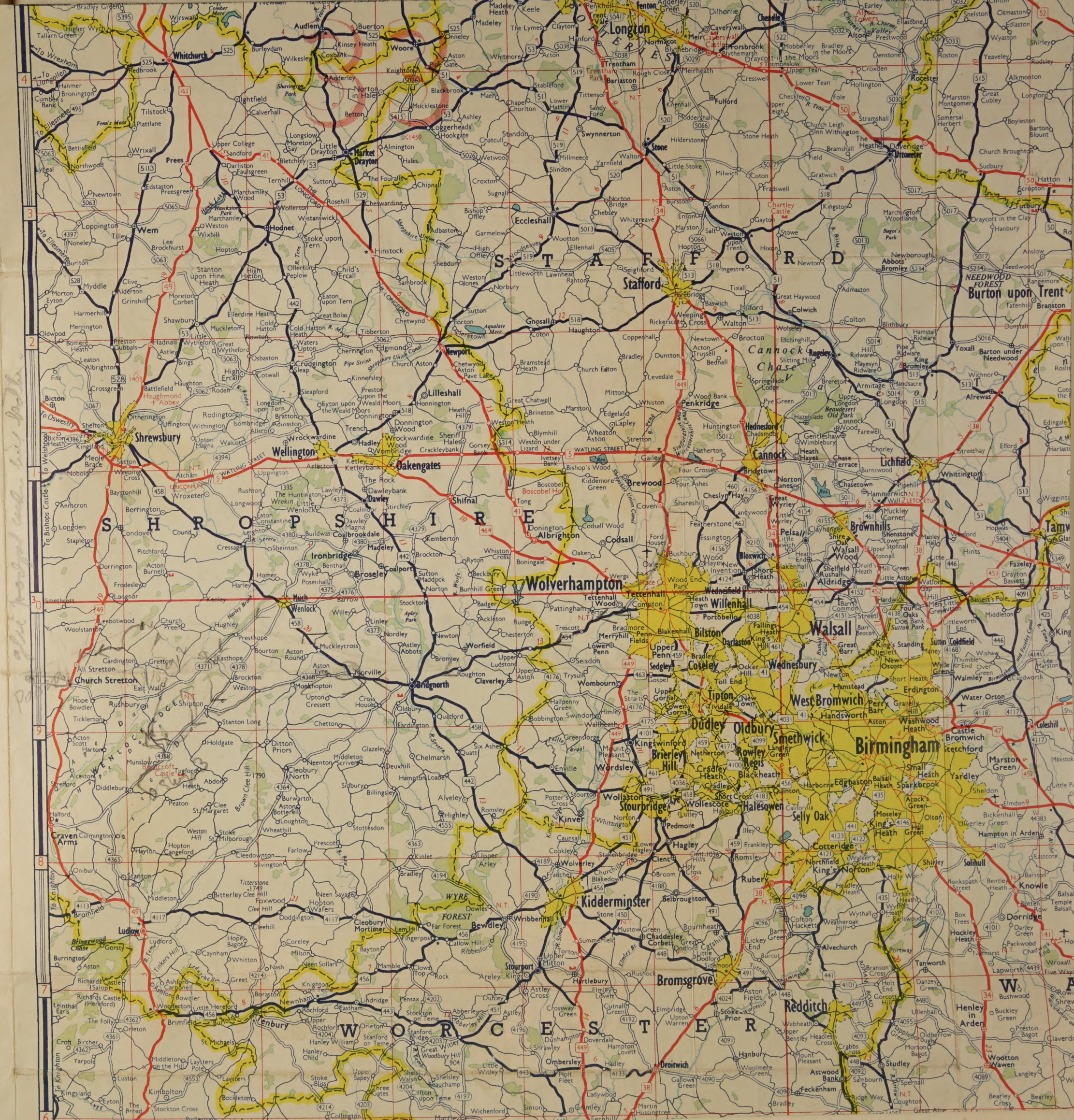
STAFFORD
SHROPSHIRE
WORCESTER
Longton
Stoke
Stafford
Eccleshall
Newport
Lilleshall
Market Drayton
Whitchurch
Wem
Hodnet
Shrewsbury
Wellington
Oakengates
Shifnal
Wolverhampton
Bridgnorth
Ironbridge
Coalbrookdale
Coalport
Broseley
Much Wenlock
Church Stretton
Craven Arms
Ludlow
Bromfield
Kidderminster
Stourbridge
Kinver
Wordsley
Brierley Hill
Dudley
Oldbury
Smethwick
Birmingham
Walsall
Wednesbury
West Bromwich
Willenhall
Bilston
Tettenhall
Cannock
Rugeley
Penkridge
Brewood
Albrighton
Codsall
Bridgtown
Lichfield
Burton upon Trent
Uttoxeter
Rocester
Tutbury
Alrewas
Barton under Needwood
Abbots Bromley
Newborough
Colwich
Great Haywood
Stretton
Gnosall
Eccleshall
Cheadle
Alton
Cresswell
Trentham
Barlaston
Swynnerton
Fulford
Hednesford
Brownhills
Pelsall
Aldridge
Bloxwich
Cheslyn Hay
Great Wyrley
Hagley
Stourport
Bewdley
Bromsgrove
Redditch
Droitwich
Ombersley
Worcester
Malvern
Tamworth
Lichfield
Sutton Coldfield
Solihull
Henley in Arden
Alcester
Evesham
Pershore
Upton upon Severn
Tenbury
Leominster
Ludlow
Bromyard
Kidderminster
Cannock Chase
Needwood Forest
Beaudesert Old Park
Bagot's Park
Chartley Castle
Alton Towers
Cauldon Canal
Shropshire Union Canal
Staffordshire and Worcestershire Canal
Birmingham and Fazeley Canal
Trent and Mersey Canal
Grand Union Canal
Birmingham Canal
Rushall Canal
Dudley Canal
Stourbridge Canal
Worcester and Birmingham Canal
Severn
Avon
Trent
Tame
Dove
Churnet
Blithe
Tern
Perry
Stour
Salwarpe
Teme
Leadon
Wye
Lugg
Frome
Malvern Hills
Clee Hill
Brown Clee Hill
Titterstone Clee Hill
Wyre Forest
Bringewood Chase
Haughmond Abbey
Battlefield
Shavington Park
Hawkstone Park
Apley Park
Fenn's Moss
Bettisfield
Prees
Whitchurch
Wem
Hodnet
Market Drayton
Newport
Lilleshall
Shifnal
Wellington
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Haughmond Abbey
Battlefield
Shavington Park
Hawkstone Park
Apley Park
Fenn's Moss
Bettisfield
Prees

We stop near Millichop to look at the soil. I am interested in a farmhouse, now in use, since it is one of the old fortified stone houses with a characteristic Norman arch of the 12th century for a doorway. A profile is made in the Stanway series - an intergrade between Low-Humic Gley and Gray-Brown Podzolic. The gray-brown surface soil with some mottling is underlain with mottled silt loam. Down the slope a ways we find a good example of the silt loam soil strictly in the Low-Humic Gley group.

We then drive to an example of the Corve series, which is a reddish-brown alluvial soil, very good for pasture if well fertilized.

We have lunch in the White Swan Inn at Munslow-Aston, a rural pub built partly in the 14th century and finished in the 15th century.

After lunch we make a stop to see a good lithosolic Podzol on the northwest side of a range of gritstone. On the southeast side of the same ridge I'm not sure whether the soils are Brown Forest, or limed Brown Podzolic. We then scurry over the hills west to Church-Stretton and go north into high hills of Cambrian age. Here is a Gley Podzol under heather with the very thin iron pan characteristic of many British Podzols.

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K-2334 Sept. 16, 1954. England. Near Shipton, west of Wolverhampton. Old farm buildings. Note the Norman arch in the farmhouse of the 12th century.

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The afternoon has slipped by and Taylor is anxious for me to return well before dinner. During this excursion I had many talks with the men on the basic purposes of soil surveys and the need for their interpretation. I have an excellent impression of Mr. Mackney and I believe he sees the great advantage of more emphasis on interpretation but finds himself urged to spend all of his time on the mapping. It seems to me that the people from the advisory center are just a bit superficial and inclined to follow their "quick tests" too much and with too little consideration to the basic kinds of soil and their management history. Of course, one may admit that it is easier!

From what Taylor had told me and from what I have been able to see today, I realize that working relationships between the Soil Survey and the Advisory Service leave a great deal to be desired. The Soil Survey is partly to blame by focusing too much of its attention on soil morphology and genesis to the neglect of interpretation. The Advisory Service is partly to blame by being unwilling to do the small amount of studying necessary to understand and to use the soil survey results. The people with me today, as well as other members of the Advisory Service at other times,

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have insisted that they need a "simple" map. They must come to realize that this is an extremely complicated area. The geology is very complicated and this has been further messed up by rather drastic geomorphological changes later. A simple soil map of this area could not help being inaccurate and of little value for farm planning.

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September 17

In the morning we go to the office and Taylor continues to discuss the organizational relationships of the National Agricultural Advisory Service. He explains that the county agricultural committees still administer the subsidy schemes, which are limited mostly to the so-called marginal areas. No subsidies are paid by the government until they have been approved by the committee.

He says that in Scotland the Advisory Service is tied to three colleges of agriculture and administered under the colleges. They get some financial help from the Department of Agriculture of Scotland. In each of the colleges the advisory people are integrated into the university system along with those in charge of the experimental farms so that the department heads are responsible for teaching, research, and advisory work. He says that the advisory work is not so intense as in Britain and Wales.

He says, generally, that the organization in northern Ireland lies somewhere between the English and Scottish plans and they have some full-time extension agents whereas there are no full-time resident "county agents" in Scotland. Taylor says that in their work he misses not having an experimental farm. Under the present system, in any section, coordination of the immediate research and the advisory work depends upon the personal relationships between individuals in the two lines of work. On paper there are advisory committees, but these do not actually function much, and certainly not in time.

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The National Agricultural Advisory Service administers some of the livestock and poultry programs. All bulls, for example, must be inspected when they are 12 to 18 months old. They are either passed by the appropriate officer of the Advisory Service, or they must be castrated. There is a similar program for boars. Their aim is to get rid of poor animals and not perpetuate bad lines. Any farmer may apply for a place in either scheme for improving bulls or boars. If the animals come up to standard, farmers get 20 to 30 pounds sterling per year if they make these animals available for service at a small fee.

He tells me that about 40 percent of the dairymen are now using artificial insemmination.

We pay brief visits to several other departments, including animal health, which is housed here, but is separately administered. I have a brief talk with the Department Director and then give a half-hour talk on soil surveys and soil conservation at a general staff conference.

We have lunch at the headquarters and then Taylor takes me over to Stafford County, near Cannock, where we meet Mr. Precious, the county agricultural officer. I'm taken on a tour of the open-cast mining operations and reclamation. It is explained that Britain is becoming very short of coal. In years past there have been deep mines here. Now shallower veins are being mined through the use of very heavy earth-moving machinery, mostly from the United States. The Coal Board is uncovering veins of relatively

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low-grade coal at about 30 to 60 feet beneath the surface. It is said that a few are worked down to 90 feet. Of course most of this land is now occupied by farmers. They are paid damages for the time that they cannot use their land at about 3 times the rent, and a terminal compensation for any permanent injury that takes place.

The land is certainly messed up by this process. The surface soil is first scraped aside into huge piles and then a reasonable attempt is made to separate the rest of the true soil from the clays, especially the heavy, sulphur-containing clay that lies just above the coal. This clay drops to about pH 2 on exposure to the air and is exceedingly difficult to work into a good tilth if it appears at the surface after refilling.

The earth above the coal is removed by great cranes and drag lines and the coal is hauled out in trucks from the deep pits. The surface is left as a mass of hilly raw earth.

We look at several places that have been reclaimed (and quite out of the order followed in the process).

The Agricultural Ministry has responsibility for overseeing the agricultural phases of this reclamation and cooperates closely with the representatives of the Coal Board who, as I understand, pay most of the bills if not all. First, huge earth-moving equipment is used to level the big piles of waste. Ideally at least the gray clay is put down first and then the lower soil.

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K-2335 Sept. 17, 1954. England. Near Cannock. Open cast coal mining with 30 to 60 feet of overburden.

K-2336 Sept. 17, 1954. England. Near Cannock. Rough surface after open cast coal mining. (Huge hill in the background is from deep-shaft mining).

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K-2336 Sept. 17, 1954. England. Near Cannock. Rough surface after open cast coal mining. (Huge hill in the background is from deep-shaft mining).

After leveling, lime is applied and some time allowed for weathering before the surface soil is returned. After this is done the common practice is to add about 4 tons of lime and a heavy dressing of a mixed fertilizer.

In the early stages of this work, it had been considered best to put the land immediately into a good grass ley. Commonly, this seeding consists of a mixture of fescue, timothy, ryegrass, and whiteclover. Just before seeding, or as a result of evidence after seeding, any necessary drainage is installed. In some places I see combinations of rather widely-spaced tile drains just below narrowly-spaced mole drains at right angles to the tile. The land is also fenced. In this area there is so much sulphur that it seems more practical to use wooden fences than wire fences. Under this method the farmer goes ahead and does some grazing, but the land is not turned back to him until the Ministry is sure it is in good condition for normal cropping.

The cost for this reclamation varies widely as might be expected. Around 300 pounds sterling per acre seems about average for land that will ultimately sell for 50 pounds sterling per acre. That is, the government takes the view that with the scarcity of agricultural soil in Britain they cannot afford to leave it in a permanent non-arable state. This cost is met partly from the general treasury as I understand it.

After levelling, lime is applied and some time allowed for weathering before the surface soil is returned. After this is done the common practice is to add about 4 tons of lime and a heavy dressing of a mixed fertilizer.

In the early stages of this work, it had been considered best to put the land immediately into a good grass ley. Commonly, this seeding consists of a mixture of fescue, timothy, ryegrass, and whitecloover. Just before seeding, or as a result of evidence after seeding, any necessary drainage is installed. In some places I see combinations of rather widely-spaced tile drains just below narrowly-spaced mole drains at right angles to the tile. The land is also fenced. In this area there is so much sulphur that it seems more practical to use wooden fences than wire fences. Under this method the farmer goes ahead and does some grazing, but the land is not turned back to him until the Ministry is sure it is in good condition for normal cropping.

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K-2342 Sept. 17, 1954. England. Near Cannock.
Leveling after open cast mining.

K-2343 Sept. 17, 1954. England. Near Cannock.
Land leveled after open cast mining. Next the top soil in the mounds in the background will be spread over the surface after an application of lime.

K-2342 Sept. 17, 1954. England. Near Cannock.
Levelling after open cast mining.

K-2343 Sept. 17, 1954. England. Near Cannock.
Land levelled after open cast mining. Next the top soil in the mounds in the background will be spread over the surface after an application of lime.

K-2337 Sept. 17, 1954. England. Near Cannock. First stage after leveling and fertilizing in reclamation after open cast mining. Seeded with timothy, fescue, ryegrass, and whiteclover.

K-2338 Sept. 17, 1954. England. Near Cannock. Good pasture on restored land of 10 years ago.

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K-2338 Sept. 17, 1954. England. Near Cannock. Good pasture on restored land of 10 years ago.

Mr. Precious explains to me as we look at different sites that he is not so sure that it is best to start with a ley. He thinks it may be better to start with a rotation including perhaps wheat and other small grains with a short ley of two years. He thinks this extra plowing of the soil and its exposure to air stimulates granulation.

In one field we see some plots that were laid out under the direction of Dr. E. W. Russell. There are 4 principal treatments as follows: (1) 7-inch plowing; (2) 14-inch plowing; (3) 7-inch plowing plus chiseling to 22 inches; and (4) 14-inch plowing plus chiseling to 22 inches. This soil looks a bit tough to me. Certainly some of the blue clay got into the upper soil and even into the plow layer. Tile drains are being installed now. In another plot where the land was leveled in 1951, I see an excellent crop of wheat that will go around 60 bushels to the acre.

The agricultural officer tells me that overseeing this reclamation work is only a relatively small part of his obligation. He has some 10,000 farmers in his county and consequently quite a big load.

I ask him about the operation of the law for dispossessing farmers. He says that in his county the committee started proceedings against 19 farmers and actually dispossessed 12 in the whole time since 1947. I ask him what effect he thinks the

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K-2339 Sept. 17, 1954. England. Near Cannock. Area reclaimed from open cast mining; leveled in February 1954. Site of plowing experiments.

K-2340 Sept. 17, 1954. England. Near Cannock. Tile drains going in on heavy soil leveled in February 1954.

K-2339 Sept. 17, 1954. England. Near Cannock. Area reclaimed from open cast mining; levelled in February 1954. Site of plowing experiments.

K-2340 Sept. 17, 1954. England. Near Cannock. Tile drains going in on heavy soil levelled in February 1954.

program had on other farmers. He replies that it is his judgment that about 15 percent of the farmers who are now good farmers would have been poor farmers except for the operation of this program and the threat of dispossession. If he is right, this is a highly significant result. He tells me that the program had most too many safeguards if anything. A farmer is first given a warning and then special attention by the Advisory Service. If there is no improvement after a year he is given another warning and further help. If this is unsuccessful he is asked to quit farming by the committee. If he does not leave voluntarily, he can appeal. Such appeals are handled by a special committee set up for the purpose, the chairman of which must be a man with legal training. Other members must be farmers from other counties having similar conditions. If they rule against him he can still appeal to the Minister of Food and Agriculture.

Mr. Precious tells me that they have had essentially no criticism for dispossessing farmers, but that they had a good deal of criticism for not dispossessing more.

We drive back to Taylor's house and change for dinner at a local pub. This is an ordinary dinner, but quite good for England. We return to have a little chitchat and then to bed.

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K-2341 Sept. 17, 1954. England. Near Cannock.
Area reclaimed from open cast mining in 1951. Present wheat crop will run 55 - 60 bushels per acre.

K-2341 Sept. 17, 1954. England. Near Cannock.
Area reclaimed from open cast mining in 1951. Present
wheat crop will run 55 - 60 bushels per acre.

September 18

After a little time in the morning and talk with the Taylors, they take me to the train for London. I leave Wolverhampton at 11:30 a.m. This is a fine day with reasonably decent temperature - about like Washington in mid-October. In London I go directly from the Paddington station to the Victoria air station. I leave by bus for the air field at 5:30 p.m. and start through immigration and customs at 6:20 p.m. At 7:10 p.m. we are away for the United States, by way of Iceland. After a slowly-served dinner, but ordinary one, I read a bit and go into my berth at 11:00 p.m.

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September 19

To my amazement I find that I have slept well when I get up at 9:10 a.m. which is 4:10 a.m. New York time. We would have been on schedule into New York City, but for some bad weather. So we land in Sidney, Nova Scotia about 5:00 a.m. We leave Sidney a little after 6:00 a.m. and are down in Idlewild Airport in New York at 9:36 a.m. The people in Pan American are very helpful and arrange for my tickets to Washington. I'm through customs in a hurry and on the bus for La Guardia Airport at 10:27 a.m.

I have never been on a slower bus. The day is gray, cool, and rainy. Despite the sleep last night the day is very long and I am tired. I get to La Guardia just in time to go in and check my baggage.

We are in the air at 11:46 a.m. We stop in Philadelphia and reach the Washington runway at 1:45 p.m. My good wife meets me and I'm home again at 3:00 p.m. very tired and glad to be here.

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